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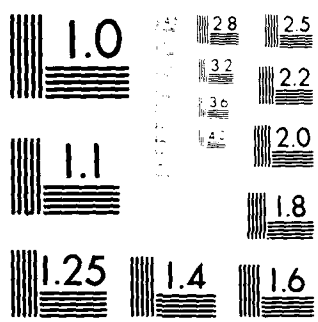


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Technical Memorandum 6-82

# EFFECT OF THE INTERACTION OF TEXT STRUCTURE, BACKGROUND KNOWLEDGE AND PURPOSE ON ATTENTION TO TEXT

Deborah P. Birkmire

April 1982
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U. S. ARMY HUMAN ENGINEERING LABORATORY
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Memory for discourse is generally an incomplete and modified version of the original text. This partial text recall has been related to structure or organization of information in text, reader's background knowledge, and reader's purpose or goal for reading a particular text. The interaction of these variables with each other and their effect on the encoding of and memory for text information was investigated. A selective attention hypothesis was tested to account for partial and modified recall from text.

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Two groups of undergraduates who demonstrated prior knowledge of either physics or music principles read three texts. Each text had been parsed into its content structure following Meyer's (1975) procedures. Sentences we e identified as high, intermediate or low in the content structure. One text presented a new laser annealing technique, the second the history of musical notation, and the third the advantages of parakeets as pets. Each text was presented sentence-by-sentence under subject control on a computer display terminal. Reading rates were recorded for each sentence. Prior to reading each text each subject received one of three sets of purpose-setting instructions which targeted specific text information to be learned. After each text was read, recognition of text sentences was tested.

Analysis of reading rates for all sentences showed that high content structure sentences were read at a faster rate on average than either intermediate or low content structure sentences by the group whose background knowledge was related to the text topic. Analysis of reading rates for targeted sentences showed that instructions to learn specific information resulted in depressed reading rates on average for sentences containing that information independent of the reader's background knowledge. Analysis of the error frequency data revealed that fewer errors were made on high content structure sentences than on lower content structure sentences.

It was concluded that (a) sensitivity to text structure appears to depend in part upon what the reader already knows about the discourse topic, (b) purpose-setting instructions appear to alter processing of textual information independent of reader's background knowledge, and (c) no evidence was found to support a selective attention mechanism that relies upon extra processing to explain partial and modified discourse memory.

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April 1982
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# CHAPTER I

# INTRODUCTION

## STATEMENT OF THE PROBLEM

Information remembered from discourse is usually not an exact replica of the original text. As early as 1894 Binet and Henri (reported in Thieman & Brewer, 1978) and later Bartlett (1932) examined memory for prose materials and found (a) memory for surface information is lost more rapidly than memory for ideas, (b) the theme of a passage is abstracted in recall, and (c) knowledge of the world interacts with the recall process. Revived interest in cognitive psychology has been directed to these recall phenomena, as well as to the role of the reader's purpose for reading a particular text. As a result of this renewed interest, evidence has been presented that this partial and modified recall of textual information is related to (a) the structure or organization of the information within the text (Johnson, 1970; Kintsch, 1974; Meyer, 1975, 1977; Rumelhart, 1977; Thorndyke, 1977), (b) the reader's knowledge of the world (Anderson, Reynolds, Schallert, & Geotz, 1977; Bransford & Johnson, 1972; Pichert & Anderson, 1979; Sulin & Dooling, 1974), and (c) the reader's purpose for reading a particular text (Gagné & Rothkopf, 1975; Frase, 1975; Kaplan & Rothkopf, 1974; Reynolds, Standiford, & Anderson, 1979; Rothkopf & Billington, 1979).

Research on these factors has tended to investigate their effects on comprehension and memory in isolation from one another. Other evidence on the constructive and reconstructive nature of memory indicates that these factors probably do not exert their influence independent of one another (Spiro, 1977, 1980). Comprehension and memory for connected discourse are more appropriately viewed as interactive processes between text variables and reader variables. Therefore, one of the goals of this research was to determine whether a reader's background knowledge and goals interact with each other and with the organization of information in text, such that encoding of and memory for text information are affected.

Virtually all the investigations reported in these areas have used memorial measures which limit the interpretations that can be given to these data. Although recall and recognition memory measures indicate that changes have occurred in the form and content of information acquired from connected discourse, they are not able to identify whether these changes are the result of encoding processes and/or retrieval processes. In the research reported here, encoding was considered to include all the processes germane to reading the text; including perception of the written symbols, interpretation of those symbols, comprehension of the content, and storage of the text information in memory. It was realized that encoding is not a unitary process. However, the research questions explored here did not necessitate the division of encoding into its component processes. Thus, another goal of this research was to assess encoding processes independent of retrieval, as a function of the reader's prior knowledge, the reader's goals, and the text structure.

## REVIEW OF RELATED LITERATURE

### Test Characteristics Related to Recall

As mentioned previously, one of the earliest findings was that the theme of a passage is abstracted in recall. Using various approaches, numerous investigators have attempted to determine those characteristics of text that are related to this thematic recall.

One approach to this issue has been an attempt to generalize the results found consistently with word lists to prose materials (e.g., Frase, 1972; Musgrave & Cohen, 1971). Imagery values of word (e.g., Yuille & Pavio, 1969; DeVilliers, 1974), serial position effects (e.g., Frase, 1969; Richardson & Voss, 1960), proactive and retroactive inhibition effects (e.g., Slamecka, 1960; Ausubel, Robbins & Blake, 1957), and clustering effects (e.g., Frase, 1969, 1970; Friedman & Greitzer, 1972) were among the phenomena investigated. There were two major problems with this line of research. The first was the inconsistency of many of the results, and the inability of the theoretical positions to account for why some prose demonstrated these phenomena and other prose did not. The second, and more severe problem, involved the nature of the stimulus materials. Many of the texts used in these studies were seldom encountered in a natural environment. For example, otherwise reasonable texts were made nonsensical by scrambling the order of the sentences (Darnell, 1963). It is conceivable that this artificiality might account for the inconsistency of findings, but the problem of generalizing to more typical discourse still remains. Still, there was a major contribution made to the study of connected discourse by this line of research. It was consistently found that memory for discourse was superior to memory for lists of words or for lists of sentences or for text sentences scrambled from their normal context. Apparently, there are some characteristics of text that distinguish it from other forms of linguistic input.

A second approach to the issue of thematic recall has focused simply on what information was remembered from text and how that information might be characterized within the text. Gomulicki (1956) had 37 prose passages read aloud to adult subjects who immediately were given a free recall task after each passage. Detailed analyses of ten of the passages, eight of which were narrative and the remaining two descriptive, showed a high selectivity in the incidence of omissions. Items important to the general meaning of the passage were recalled, less important items were omitted. The least well recalled items were purely descriptive elements. Verbs were found to be recalled best, followed by agents, followed by the effects of recipients of the action. He termed this the "agent-action-effect unit" and it corresponds to Fillmore's (1968) cases and Grimes' (1975) lexical predicates. He concluded that this pattern of recall was the result of an abstractive process in recall, or mnemic abstraction. Further, he speculated that the mechanism by which this operated was a ranking of text items according to importance when comprehending the text, and distribution of attention accordingly.

In another attempt to delineate which aspects of text are recalled best, Johnson (1970) used a normatively determined measure of relative importance of an idea within a passage. He called this its structural importance. Independent raters divided narratives into pause acceptability units, i.e., text segments separated by pauses which might be used to catch a breath, to give emphasis to the story, or to enhance meaning. A second group of subjects was told that these pausal units differed in their structural importance to the whole story and that some could be eliminated without destroying the essence of the story. These subjects eliminated unimportant units until only one-fourth, one-half, and three-quarters of the original number of words remained in the story. The highest structural importance scores were assigned to those units not deleted, the lowest scores were assigned to those units deleted under the one-quarter deletion instructions. The structural importance ratings of the unit were related to the free recall of that unit by a third group of subjects such that the higher rated units were more likely to be recalled. Using similar importance rating techniques, Brown and Smiley (1977) and Christie and Schumacher (1975) both showed that children also recall elements judged to be more important better than elements judged less important.

There have been two problems with this approach to identifying text characteristics related to recall. The first is that evidence has been presented by Meyer and McConkie (1973) that normative ratings of importance do not always predict recall. Meyer and McConkie had raters assign scores in two passages to idea units, i.e., single, meaningful pieces of information conveyed by the passage, according to their perceived importance. After a second group of subjects listened to the passages, recall frequency scores from this group were correlated with the rated importance scores. The correlations were approximately zero for one passage and statistically significant for the second one. The second problem revolves around the theoretical issue of what defines "importance." Normative definitions of importance lack the explanatory power provided by a linguistic or psycholinguistic theory of importance. A more fundamental question is how do people know that one bit of information is "more important" than another piece of information.

Recent efforts have focused on methods of determining the relative importance and relationship of text elements that are independent of any particular text. One approach has been the formulation of story grammars (Mandler & Johnson, 1977; Rumelhart, 1977; Thorndyke, 1977). Typically, these grammars are applicable to a limited set of stories, i.e., those that seem to involve a sort of problem-solving motif. These particular narratives seem to follow the same scenario: First, something happens to a protagonist which sets up a goal that must be satisfied. The remainder of the story is a description of the protagonist's goal-seeking behavior and resolution of the problem. Story grammars attempt to formalize the syntactic rules governing this general structure. Presumably, the grammars are used to relate the surface structure of stories to a story schema. A story schema is generally defined as the idealized internal representation of the parts of a typical story and the relationships among the parts.

Research on story grammars generally uses them to identify the goals, subgoals, attempts to achieve the goals, and methods that are used in these attempts of a particular story. Most grammers, though not all, tend to place these story constituents into hierarchical structures. For example, Rumelhart's grammar places the following story constituents at higher-level nodes: The initiating event, the goal of the protagonist, the protagonist's attempt to attain that goal, and the final outcome. Other information, such as subgoals, attempts to attain these embedded goals, and the outcomes of these attempts are placed at lower-level nodes. Much of the empirical work on story grammars has attempted to determine whether higher-level constituents in these hierarchies are better remembered or mentioned more often in story summaries than lower-level constituents. Both adults (Bower, 1976; Mandler & Johnson, 1977; Rumelhart, 1977; Thorndyke, 1977) and children (Mandler & Johnson, 1977; Stein & Glenn, 1979) tend to remember information located at higher level nodes better than information located lower in the hierarchy.

Numerous criticisms have been directed toward the story grammar approach to understanding text (e.g., Black & Wilensky, 1979). However, the major criticism with respect to the research problem stated earlier in the introduction is the grammar's lack of generalizability to other literary genres. Although the type of text addressed by story grammars is very common both within and across many cultures, it is not the type of connected dicourse generally used to convey information about subject matter content areas.

Several researchers (Crothers, 1972; Frederiksen, 1972; Kintsch, 1974; Meyer, 1975) have used methods of determining textual relationships that are more generally applicable to texts of any genre. The two methods of text analysis most widely used are those of Kintsch (1974; Kintsch & van Dijk, 1978) and Meyer (1975, 1981). There appear to be both empirical and theoretical reasons for their prevalence. Unlike other methods (Crothers, 1972), both the Kintsch and Meyer analysis methods have been successful in relating subjects' recalls to the text structure generated by their analysis (Caccamise & Kintsch, 1978; Kintsch, Kozminsky, Streby, McKoon, & Keenan, 1975; McKoon, 1977; Meyer, 1975, 1977; Meyer & McConkie, 1973). A second reason for their wide usage may be that they are more parsimonious. For example, Frederiksen's (1972) method required the generation of two graphs, one semantic and one logical, to depict the text structure. Further, there are difficulties in both his and Crother's systems showing intersentential relationships.

The text analysis developed by Meyer (1975) is based on the linguistic work of Grimes (1975) and Fillmore (1968). Her algorithm for analyzing the structure of the content of a text yields hierarchically arranged tree structures. The nodes in these hierarchical structures contain content words and phrases from the passage, and the lines connecting the nodes show spatially how these content words and phrases are related linguistically. Meyer has labeled these displays of the information within a text the content structure of the text.

The content structure of a text illustrates the relationship of one text element, i.e., the content words or phrases, located at one node, to text elements at other nodes. That is, it shows which elements are superordinate as well as the elements that they subsume. Top-level elements relate to lower-level elements in a direct downward path in the structure. These top-level elements dominate their subordinates. Lower-level elements describe or elaborate upon their superordinate elements.

Meyer (1975, 1977) used this text analysis procedure to investigate the relationship between the height of information in a content structure and its subsequent recall. She embedded an identical target paragraph in two different passages. In one passage, the target paragraph was high in the content structure, while in the second passage it was low in the content structure. After reading one of the two passages, college students free recalled the information from it. She reported that information from the target paragraph was better recalled when it was high in the content structure of a passage, than when it was low in the content structure of the passage. This finding was replicated by Britton, Meyer, Simpson, Holdredge, and Curry (1979) and extended to ninth-grade good comprehenders (Meyer, Brandt, & Bluth, 1980).

The procedures of either Kintsch or Meyer could have been used to identify the text organization in the research presented here. However, Meyer's system was selected for several reasons. The primary one was that her analysis system had a more appealing theoretical base. It is based on linguistic work which has wide acceptance and it specifies the logical relationships between information within a text, while Kintsch's system is based on an argument repetition theory. Meyer's approach also produces a more articulated structure (Meyer, 1981). A related aspect that was considered in choosing the Meyer scheme was the method used to determine the superordinate node of a hierarchical structure. In the Kintsch analysis scheme superordinate propositions are chosen intuitively. In contrast, the Meyer approach defines the superordinate idea as the content bound by the top-level structure, i.e., the superordinate relation which can subsume under it the remaining ideas of the text. A secondary reason for using the Meyer procedure was that it has generally been used to analyze longer expository texts, while Kintsch's procedure has mostly been used to analyze shorter, descriptive passages. Therefore, Meyer's procedure provided an empirical base on texts of similar composition and length to the experimental ones.

## Prior Knowledge in Comprehension and Recall

A second variable of interest with respect to the partial and modified recall of information from connected discourse has been the reader's prior knowledge. In contrast to the researchers studying text structure who have typically treated text structure as an inherent property of the text, researchers investigating the role of prior knowledge have attempted to demonstrate that comprehension of and memory for connected discourse is an interactive process between the printed page (or spoken word) and the reader (or hearer). "Meaning" is not viewed as residing solely in the

linguistic input. Rather meaning is a "construction" based on the context in which it is presented as well as the linguistic input. Context has been very liberally defined to include linguistic knowledge and world knowledge.

There are some obvious overlaps between what constitutes prior knowledge and what constitutes text structure as discussed previously. For example, Meyer's content structure in part depends upon Fillmore's case grammar. Some prior knowledge of the linguistic concepts involved in case grammar is necessary on the comprehender's part in order to discern the "inherent" text structure defined by Meyer. However, the present research was specifically focused on the role of the reader's existing knowledge of or previous experience with the particular content area of a text. Therefore, the literature reported here will focus on that specific topic.

Several studies have demonstrated that the interpretations given to some passages are dependent upon the subject's knowledge of the context in which the information is presented. In one approach of this type, subjects were given vague, metaphorical passages to read that lacked specific referents. It was found that comprehenders and recall was enhanced when these passages were accompanied by either a descriptive title (Dooling & Lachman, 1971) or picture (Bransford & Johnson, 1972). In a second approach to experimentally defining context, biasing titles were found to influence predictably comprehension of ambiguous passages (Schallert, 1976) and dual-theme passages (Kozminsky, 1977).

Although the previously cited work provided strong evidence that one's knowledge of the world interacted with comprehension and memory processes, there were limitations to the interpretations given to these results. Generally, the materials used were constructed for the purposes of the experiment and were rarely of a type encountered in natural settings. The results reported by Sulin and Dooling (1974) are less susceptible to such criticisms. Subjects were told to read a short biographical sketch. Those who were told that the passage was about a famous person made more false positive recognitions on well-known facts about that person than subjects who read the same passage but were told that it was about a fictitious person. Brown, Smiley, Day, Townsend and Lawton (1977) used similar manipulations to extend these findings to children. In one study children who were told that a passage was about a television character made more false recognitions of sentences based on the television series than did children who were told that the passage was about an escaped convict. In a second study reported by these authors, children were asked to read a passage which they were told was either about an Eskimo or desert Indian tribe. Intrusions in recall were consistent with the topic given. A related study has been reported by Pichert and Anderson (1977). They found that when subjects were told to read a passage from one of two perspectives, a text element's significance in terms of the given perspective determined whether the text element would be learned and recalled.

Other investigations have shown that the interpretation given to connected discourse may be influenced by the subject's specific background. Anderson, Reynolds, Schallert, and Goetz (1977) presented ambiguous passages to two groups of students from different major areas of study. The interpretations given to those passages were consonant with the respective backgrounds of the groups. In an experiment that investigated the influence of cultural background on reading comprehension, Steffensen, Joag-Dev, and Anderson (1979) had two groups of students from different backgrounds read and recall texts describing weddings in their two countries. They found that subjects recalled more text elements rated important by subjects with the same cultural background, produced more culturally appropriate elaborations of the native passage, and produced more culturally based distortions of the foreign passage.

In sum, recent research has demonstrated that prior knowledge, whether in the form of contextual information or specific pre-experimental knowledge, can influence the comprehension of and memory for connected discourse.

## The Reader's Purpose in Comprehension and Memory

Another area of research that is relevant to this discussion has examined the role the reader's purpose plays in comprehension and recall. Frederiksen (1975) instructed subjects to read a passage in order to solve a problem. He found that the amount of inferred and overgeneralized semantic information in their recalls was related to those instructions. Investigators (Gagné & Rothkopf, 1975; Frase, 1975; Kaplan & Rothkopf, 1974; Reynolds & Anderson, 1980; Rothkopf, 1976; Rothkopf & Kaplan, 1972) have consistently reported that readers who are given explicit descriptions of learning goals in the form of questions asking for specific information (a) learn and recall more goal-relevant textual information than incidental background information, and (b) remember more goal-relevant material than readers who have been generally instructed to learn as much as possible about a text, but to whom explicit learning goals have not been described.

More recent work in this area has focused on the processing activities of the reader that might be related to this selective recall of textual material. Rothkopf and Billington (1979) monitored eye movements and recorded inspection times while subjects read a passage in order to learn pre-memorized goals. They found that average segments of text that contained incidental information were inspected relatively quickly, while segments of text that contained goal-relevant information were inspected relatively slowly. They also reported a positive correlation between goal processing time and goal achievement. In a similar view, Reynolds, Standiford, and Anderson (1979) reported that subjects who read text with inserted questions spent longer inspection times on text segments that contained information of the type needed to answer the questions. They proposed a selective attention processing strategy to account for the effects of inserted questions.

It can be concluded that instructions to learn specific information from text can influence processes associated with comprehension and encoding as well as processes associated with memory.

RESEARCH QUESTIONS

There is evidence that each of the previously reviewed variables in some way is related to the partial and modified recall of information from connected discourse. Unfortunately, each of these variables has usually been investigated in isolation. For example, typically reader's recall of textual information is studied as a function of the text structure (Kintsch & Keenan, 1973; Meyer, 1975) without examining the reader's prior knowledge of the text topic or the purposes for which they are reading. Therefore, one purpose of this research was to determine whether a reader's prior knowledge and purpose for reading interact with each other and the text structure, such that encoding of and memory for text information are affected.

Virtually all of the previously cited investigations have used recall or recognition memory measures of performance. These memorial measures indicate that changes have occurred in the form and content of information presented in connected discourse. However, one of the limitations of recall and recognition memory measures is that these memorial changes could be the result of comprehension and encoding processes, or retrieval processes, or both. One attempt to extricate the influence of contextual knowledge during retrieval from those influences during comprehension and encoding was reported by Anderson and Pichert (1979). They gave college students a passage to read with instructions to read it from one of two perspectives. It was found that idea units relevant to the perspective from which it was read were learned and recalled better than idea units irrelevant to that perspective. The subjects were then asked to recall information relevant to the other perspective. Since previously unrecalled information now appeared in the recall protocols, the use of contextual knowledge during retrieval, independent of comprehension and encoding, was implicated. Although they found evidence which can attribute differences in recall due to retrieval processes, they did not address the issue of differences in recall due to comprehension and encoding processes which they acknowledge could be operating independently. Certain results have been reported that support that acknowledgment in that they seem to demand an interpretation that places the locus of contextual effects during encoding of prose materials. For example, Bransford and Johnson (1972) found that recall of a vague prose passage was aided when a descriptive picture was presented prior to the passage, but that presentation of the picture after the passage did not aid recall. However, since recall measures were used, the interpretation of the data is limited because contextual effects were not assessed independently of their possible effects during retrieval. Therefore, a second purpose of this research was to investigate the influence of prior knowledge, purpose for reading and text structure on the encoding of written discourse, as measured by indices that were relatively free of the influence of retrieval processes.

The research to be reported here was designed to test one possible processing mechanism that may account for selective recall and recognition. It has been suggested that the partial memory for information from written discourse is the result of a strategy of selective attention during comprehension and encoding (Britton, Meyer, Simpson, Holdredge, & Curry, 1979; Gomulicki, 1956; Meyer, 1975). According to this hypothesis, the

reader selects important or relevant text elements and processes this information to a deeper level than those text elements that are less important or irrelevant. The terminology "deeper" level is used here in the sense proposed by Craik and Lockhart (1972). All levels of representation would entail such preliminary processing operations as perceptual processing, word identification, and partial syntactic analysis. Further, this view suggests that, although all text elements may be subjected to some semantic analysis, the amount and degree of processing devoted to each may differ. Deeper levels of representation may involve more elaborate semantic analyses, possibly resulting in more abstract representations, than more shallow levels of representation. This more elaborate semantic analysis may involve such memory-inducing cognitive activities as rehearsal, elaboration, development of mnemonics, creating images, and creating associations between related elements of important information. Less important or irrelevant information is not selected for special processing, and consequently, is less likely to be recalled.

It was considered plausible that a reader's background knowledge, a reader's goal and the text structure might determine the criteria for selection of text information as relatively important or relatively unimportant. Presumably information determined to be more important would be subjected to special processing. This special processing could account, in part, for the superior memory of important information as compared to less important information. Therefore, another purpose of this research was to test this selective attention hypothesis. In order to test this hypothesis, however, it was assumed that processing of information to a deeper level would be reflected in longer reading times for that information. This assumption is based on the premise that one might expect that special processing of certain text elements would entail extra time. One caveat needs to be made at this point. Although intuitively pleasing to suspect and to assume that more time is required for "special" or "different" processing, this is not a logical necessity. Different processes need not require different amounts of time.

There is empirical evidence to suggest that an increase in inspection time or reading time for certain text elements is associated with an increase in the recognition and recall of those elements. Massaro (1970) found that memory for an item from a word list was directly related to the time spent processing that item. Cirilo and Foss (1980) measured reading times for sentences in stories, where a specific sentence appeared at one hierarchical level in one story and at another hierarchical level in a second story. In two experiments they found that high-level sentences took longer to read than low-level sentences. Recall data supported the structural assignment of critical sentences. Less direct evidence was reported by Thorndyke (1979) who investigated reading times for news articles that had been parsed into text elements termed propositions. These were defined as a clause or sentence that contained an action or stative verb. He found that the mean reading time per proposition was longer for a condensed version of a news article than the mean reading time per proposition for the original version of the article. He suggested one possible explanation for the differences in reading times between the two versions. He proposed that the less theme-relevant or extraneous information in the original was processed less carefully, and hence at a faster rate, than the more theme-relevant information. However, he acknowledged that he did not have a direct test of this hypothesis.

There has been one direct attempt to test a selective attention hypothesis as a function of text structure. Britton, Meyer, Simpson, Holdredge, and Curry (1970) measured reading times for target paragraphs that varied in their height in the content structure. They were unable to detect differences in inspection times as a function of the paragraph's level in the content structure. However, there are two major problems with their design. The first is a theoretical one, dealing with the size of the unit they were measuring. All previous empirical evidence in support of selective allocation of processing times has used small units about the size of sentences. They concede that selective attention strategies may only be available for small units and not for units the size of a paragraph. The second problem is methodological. Inspection times were measured by the experimenter with a stopwatch when a subject announced that a page was being turned. If differences in processing times are small in magnitude, and empirical evidence supports that expectation, then this technique is not sensitive enough to detect those differences. Further, although they contend that the probable error of observation is small, the reliability of this technique is still questionable. This is especially so if one is expecting differences that are small in comparison with the error of the measuring instrument.

As mentioned previously with respect to the role of the reader's purpose, Reynolds, Standiford and Anderson (1979) investigated the effect of inserted post-questions about a restricted category of information on the inspection time devoted to short text segments. They found that subjects who received inserted questions spent more time on the parts of the text that contained information of the type needed to answer the questions than on incidental text segments. Additionally, Rothkopf and Billington (1979) examined the effect of pre-memorized learning goals on inspection time for text neigborhoods containing goal-relevant information. Using segments of text of from one to three paragraphs in length, they found that averaged group data indicated that subjects processed goal-relevant segments more slowly than incidental segments of text. Presumably, in all of these cases, the increase in reading or inspection time is an indication of extra or differential processing.

## RESEARCH HYPOTHESES

### Hypothesis 1

It was expected that specialized knowledge of a topic could be used to attend to and process information selectively based on its relative height within a text's content structure. Consequently, a significant interaction between a reader's prior knowledge and the height of text elements in the content structure would be expected such that prior knowledge will increase differential attention to text elements based on their height in the hierarchical text structure.

Hypothesis 2

It was expected that those readers with specialized background knowledge would be better able than readers without specialized background knowledge to use that knowledge to direct attention to information designated as critical by the purpose setting instructions. Therefore, a significant interaction between prior knowledge and purpose would be expected on a measure of attention to text.

Hypothesis 3

If selective attention occurs, such that material higher in the content structure received greater attention and presumably is processed to a deeper level than material lower in the content structure, then recognition memory should be (a) better for material high in the content structure than for material low in the content structure, and (b) correlated positively with a measure of attention to the part of the text that contains the information in the recognition memory test.

# CHAPTER II

# METHODOLOGY

## SUBJECTS

### Materials Used for Subject Selection

Two tests were used to determine subject selection. In order to prevent confounding the factors investigated with reading ability, The Nelson-Denny Reading Test, Form C (Brown, 1973) was used as a screening device. Since skilled readers were required, it was determined that subjects must score the equivalent of a college sophomore level on the combined vocabulary and comprehension measures of the test for inclusion of their experimental data.

A second test was used as a screening device for background knowledge in physics (primarily electronics and electromagnetism) and music (primarily musical notation) (see Appendix A). This test was compiled from sample and study questions for the Graduate Record Examination Advanced Tests in Physics and in Music. Twenty questions in each of the two major areas were selected. Scores for each area of this test were used to insure that the experimental groups differed on the dimension of background knowledge in those areas.

### Subject Selection Procedures

The subjects were undergraduates enrolled at the University of Delaware. They were recruited primarily from upper division physics, electrical engineering and music majors. They were paid ten dollars for their participation in two sessions, each approximately one hour in length. The first session consisted of the experimental tasks. The screening tests previously described were administered during the second session, so that content of these tests could not confound the experimental results. The screening tests were given either individually or in small groups of no more than 15 subjects. Administration of the Nelson-Denny Reading Test (Brown, 1973) followed the regular procedures outlined in the Examiner's Manual (Brown, 1976). Subjects were given unlimited time to complete the test of background knowledge.

All subjects reported that the experimental texts read during the first session contained information that was new to them.

Table 1 gives descriptive information for the 45 physics and engineering majors (Physics Group) and the 45 music majors (Music Group) who met the requirements for inclusion in the analyses.

TABLE 1

Descriptive Statistics on Subject Population

| | Sex | | Year in College | | | | Nelson - Denny Reading Test | | | | Background Knowledge Test** | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Vocabulary & Comprehension* | | Reading Rate (wpm) | | Physics | | Music | |
| | M | F | 1 | 2 | 3 | 4 | $\overline{X}$ | SD | $\overline{X}$ | SD | $\overline{X}$ | SD | $\overline{X}$ | SD |
| Physics Group | 40 | 5 | 0 | 12 | 17 | 16 | 122.22 | 20.28 | 278.58 | 76.82 | 10.43 | 3.89 | 1.16 | 1.85 |
| | | | | | | | ***GE = 15.0 | | | | Range 3.25 to 19.00 | | Range -1.50 to 5.75 | |
| Music Group | 20 | 25 | 1 | 3 | 15 | 16 | 109.67 | 18.46 | 308.53 | 103.89 | 0.24 | 0.60 | 11.50 | 2.54 |
| | | | | | | | ***GE = 15.0 | | | | Range -0.75 to 2.00 | | Range 6.50 to 16.50 | |

* Raw score of 80 approximates a college sophomore reading level.

** Score = number correct minus one-fourth number wrong. Total possible = 20.

*** Grade Equivalent.

## MATERIALS

### Texts

A practice passage and three content specific passages were taken from articles that appeared in published journals or books. Some rewriting of the passages was necessary in order to control for certain parameters of the passages, i.e., number of words per sentence and number of words per passage. The practice passage (see Appendix B) was a short news article about kangaroos as an endangered species which appeared in Science (Holden, 1980). A research report (see Laser Text Appendix B) on a new annealing technique to be used with an ion implantation procedure was chosen from Scientific American (Warmed-Over Chips, 1980) for three reasons; (a) it contained terminology and content with which upper-division physics and engineering majors should be familiar, but with which music majors would probably not be, (b) it was judged to be comprehensible to music majors despite their lack of familiarity with the area, and (c) it presented new information that was not common knowledge even among physics and engineering majors. A second passage (see Notation Text Appendix B) about the history of musical notation was chosen from Music Educators Journal (Cromleigh, 1977). Similar logic was applied in the selection of this particular excerpt. Advanced music majors were likely to know the terminology and background information, but not the specific content of the article. Conversely, physics and engineering majors were likely to be unfamiliar with both the terminology and background information, although they were judged to be capable of understanding the text. A third passage (see Parakeet Text Appendix B) about parakeets as pets was selected from research reported by Meyer (1975) who had used it to investigate the effect of content structure on memory for prose. In addition to the expectation that it would contain terminology and content equally familiar to both groups of subjects, it was used as a control for the presentation technique used in the investigation.

Various descriptive measures of these texts are presented in Table 2. In order to demonstrate equivalence with regard to average sentence length between the three experimental passages, an analysis of variance was performed using the number of words per sentence as the dependent measure. All contrasts between the experimental passages were nonsignificant.

TABLE 2

Description of Experimental Texts

| | Practice | Laser | Notation | Parakeets |
|---|---|---|---|---|
| Number of sentences | 16 | 27 | 29 | 31 |
| Number of words | 354 | 564 | 662 | 641 |
| Mean number of words per sentence | 22.1(6.1) | 20.9(6.7) | 22.8(5.7) | 20.7(6.1) |
| Range of words per sentence | 13-32 | 12-32 | 13-32 | 12-31 |

Meyer's (1975) procedures were used to analyze the content of the three experimental texts into content structures as described in the introduction. Following the procedures outlined by Meyer (1975, personal communication) three raters parsed each of the three experimental texts into its respective content structure. Each level of the resulting hierarchial structure was assigned a sequential numerical rating with one representing the top-most node or information unit.

Since the design of this investigation and the technology available precluded measuring reading times on units of text smaller than a sentence, some measure of each sentence's position in a content structure was needed. This was determined by averaging the individual ratings of information units within each sentence. Each rater assigned each sentence a mean rating in this way. Reliability coefficients were calculated between all possible combinations of raters for all three experimental texts. The inter-rater reliability coefficients ranged from .85 to .95 (see Appendix C for specific coefficients).

While these procedures allowed finer discriminations to be made, the purposes of the present investigation required that sentences only be grouped into three levels: high, intermediate and low in the content structure. Therefore, each rater rank-ordered the sentences in each passage according to the assigned content structure rating. Those sentences that fell within approximately the upper third or lower third of each rater's distribution were assigned to the high content structure category and low content structure category, respectively. The specific sentence assignments for each passage are displayed in Appendix D.

### Recognition Memory Tests

The recognition memory tests were constructed by selecting 12 sentences, four from each content structure category, from each passage. These sentences were chosen so that three sentences, one from each category, occurred in approximately the same area of the text in order to counterbalance for any serial position effect. Six of these 12 sentences from each passage were selected randomly and were altered semantically from the original wording of the text, so that identification of changes would be passage dependent. The recognition memory tests for each passage are displayed in Appendix E.

## DESIGN

The design of the investigation incorporated two between-subjects factors and three repeated measures, as follows:

1. The first between-subjects factor was the subjects' prior knowledges as represented by their scores on the tests of background knowledge. There were two levels of this factor with knowledge of physics, primarily electronics and electromagnetism, constituting one group and knowledge of music, primarily notation, the other group.

2. The second between-subjects factor was the purpose for which the subjects were reading. This was varied by giving the subjects different purpose setting instructions prior to reading the passage. There were three types of instructions. One set of instructions was very general asking the subject to read for the main idea of the passage. A second set of instructions directed attention to three pieces of information that had been determined to be high in the content structure of the passage to be read. Each piece of information specified was found in a single sentence. The third set of instructions also consisted of directions to pay particular attention to three pieces of specific information in a passage. However, that information was determined to be low in the content structure. Again, each direction contained information found in a single sentence (see Appendix G).

3. The first within-subjects factor was the passage read. There were three passages as described in the materials section.

4. The second within-subjects factor was whether the passage was being read for the first or second time.

5. The third within-subjects factor was the level of each sentence in the content structure. Again, the sentences were rated and categorized as relatively high, intermediate or low in the content structure.

Therefore, the design was a 2 x 3 x 3 x 2 x 3 completely crossed factorial. Subjects from each of the two prior knowledge groups were tested in random order. They were assigned to one of the three instructional conditions randomly. Since the order in which sentences of varying content structure ratings were presented was determined by the passage structure, this factor could not be counterbalanced. However, examination of the sentence ratings revealed that sentences of varying ratings were distributed across the passage. In order to counterbalance presentation order among the passages, six presentation orders were used, so that all possible combinations were presented.

Two dependent variables were measured as follows:

1. The reading time for each sentence on each passage was measured and converted into a reading rate measure, i.e., the number of words in a sentence was divided by the time to read the sentence in minutes. The mean of the reading rate for all sentences at each level of content structure for each reading for each passage was then calculated. Therefore, there were 18 mean reading rates for each subject.

2. The second dependent measure was the frequency of errors on the recognition memory test. The total number of errors on sentences at each content structure level for each passage was calculated for each subject. Therefore, there were nine error frequencies for each subject.

## APPARATUS

A CDC PLATO terminal was used to present both the instructions and stimulus materials for the experimental portion of the investigation. The PLATO terminal is an interactive plasma-display, computer-graphics terminal. The plasma screen is a translucent plastic-covered, glass panel which provides a 21.6 cm by 21.6 cm viewing area. Thirty-two lines of 64 characters length could be displayed. The terminal wrote at 180 characters per second. These characters could also be erased at the same rate of speed, or the whole screen could be erased at once. The terminal had a keyboard similar to one for a standard typewriter.

A magnetic floppy-disk drive was used so that presentation of stimulus materials and measurement of reading times were not affected by a time-sharing system. All responses were stored by the Cyber 173 computer to which the terminal was connected.

## PROCEDURES

Subjects were tested in two sessions, each lasting approximately one hour. During the first session, subjects individually read the experimental texts on PLATO. The second session involved administration of the standardized reading test and the background knowledge test.

During the first session, subjects were tested in a small laboratory room that contained the PLATO terminal. Each subject was first asked to read and sign a "Certificate of Informed Consent" (see Appendix F).

Each subject then read an introductory set of directions presented on the PLATO terminal that explained the operation of the PLATO system and the general procedures used in the study (see Appendix G). These included (a) directions for reading the passages, (b) directions for taking the recognition memory test, (c) an explanation of the payoff matrix, and (d) a recommended reading strategy. The payoff matrix was included in the design of the investigation in order to encourage subjects to read as quickly as they could with understanding and to discourage them from attempting to memorize the experimental passages. The matrix was used to determine a subject's bonus in addition to the flat fee paid for participation in the study. The payoff matrix was based upon reading time data collected during piloting of the materials.

Following the introductory directions all subjects read a general set of instructions about the passage they were about to read (see Appendix G). However, the instructions that followed these general passage directions were dependent upon a subject's purpose-setting instructions. Subjects were assigned to one of the three purpose-setting instructional conditions based on the order in which they were tested. Examples of the purpose setting instructions given to each of the three conditions prior to reading the parakeet passage follow:

General: This next passage is about the advantages of parakeets as pets. You will be asked several questions later about various aspects of the topic. The passage will be presented when you press NEXT.

Specific High: After reading the next passage you will be asked several objective questions about it. Some of the questions will be about (a) the initial expenses, (b) where used cages can be found, and (c) the behavior that makes parakeets delightful.

Please memorize these topics now. When you are satisfied that you have learned them press NEXT.

Specific Low: After reading the next passage you will be asked several objective questions about it. Some of the questions will be about (a) the natural habitat of parakeets, (b) the number of colors of parakeets, and (c) what provides an inexpensive treat.

Please memorize these topics now. When you are satisfied that you have learned them press NEXT.

Please refer to Appendix G for detailed instructions for all passages.

At this point subjects in both the Specific High and Specific Low instructional conditions were required to recall in writing on index cards the three topics they had been instructed to learn. They were told to give the index cards to the experimenter who evaluated whether the topics were correct. This procedure was repeated until the subjects in these conditions recalled the topics correctly twice in succession. A two-way multivariate analysis of variance (group X instructional condition) was done by the number of trials to reach criterion. There was a significant instructional condition by text interaction ($F = 3.22$, df 2/55, $p < .0359$), such that, in the specific high condition more trials were needed to learn the laser topics to criterion than were needed for the parakeet topics in either instructional condition (see Appendix H for a table of cell means).

After reading the purpose setting instruction, subjects read the practice passage one sentence at a time. Each succeeding sentence of the text was presented directly beneath the previous sentence when the subject pressed the NEXT key. All sentences were left-justified. As one sentence was displayed, the previous one was erased. This procedure was followed until the bottom of the screen was reached at which time the next sentence was presented at the top of the screen. After reading the passage once using this technique, a short pause preceded the second reading of the passage. The second presentation and procedures were identical to the first reading.

Following completion of the second reading of the practice passage, subjects were given directions for taking the recognition memory test (see Appendix G). At this point each of the six statements in the recognition memory test (see Appendix E) appeared individually. The order of sentence presentation was randomized and remained constant for all subjects.

After completion of the recognition memory test, feedback was provided to each subject as to the total time to read the passage twice, the number of points earned per correct answer, the number of correct responses, the number of points earned for this passage and the total number of points accumulated.

These procedures were repeated with the three experimental passages. The order in which these passages were presented to subjects was determined by the subjects order in testing.

At the end of the first session, any questions that the subjects may have had about the experimental treatment were answered by the experimenter.

The second session involved administration of subject screening devices as described in the Subjects section.

CHAPTER III

RESULTS

## READING RATE FOR ALL SENTENCES

### Description of the Data

A natural logarithmic transformation was applied to the raw data in order to minimize violations of the assumptions of normality and homogeneity of variances underlying the analysis of variance model (Kruskal, 1968; Olson, 1976; Winer, 1971). Inspection of the transformed data indicated that "outlier" points existed in a number of score vectors. That is, a number of data points did not appear to be consistent with the remaining observations in the sample. Therefore, statistical tests and the associated probability distributions of those tests (Grubbs, 1950) were used to identify outlying observations. The two most extreme observations from the mean of a sample were tested using the statistics given in Appendix I. Each sample consisted of the reading rates of the 15 subjects in each group by instructional condition for each of the 174 sentences. Approximately 1.3 percent (203 of 15,660 observations) of the data points were found to be discordant at a .05 probability level (Grubbs, 1950). The mean of the appropriate sample excluding the outlier(s) was substituted for each outlying observation(s).

Since the comparisons of interest were between content structure ratings, a mean reading rate was calculated for each content structure category (high, intermediate and low) for each text (Laser, Notation and Parakeet) for each reading (first and second time) for each subject. Therefore, there were 18 mean reading rates for each subject which were used in this analysis.

The means, standard deviations and geometric means of the logarithmic transformed data for each of the three texts are displayed in Tables 3, 4, and 5.

### Analysis

The data were subjected to a five-way fixed effects nonorthogonal multivariate analysis of variance, since the assumptions for the mixed-model analysis of variance were not met. Group identification (physics and music) and instructional condition (general, specific high and specific low) were treated as between subjects factors. Text (Laser, Notation and Parakeet), reading (first and second time) and content structure rating (high, intermediate and low) were repeated measures. As indicated by Finn's MULTIVARIANCE program, contrasts between the various cell means were specified as the parameters to be entered into the analysis. Results of the tests for the main effects and interactions are displayed in Appendix J (see Table 1J).

## TABLE 3

Means, Standard Deviations and Geometric Means of the Transformed (LN X) Reading Rates (WPM) for the Laser Text by Reading, Content Structure, Group and Instructional Condition

**First Reading**

| Group | High | | | Intermediate | | | Low | | |
|---|---|---|---|---|---|---|---|---|---|
| | $\bar{X}$ | SD | Geo $\bar{X}$ | $\bar{X}$ | SD | Geo $\bar{X}$ | $\bar{X}$ | SD | Geo $\bar{X}$ |
| Physics | | | | | | | | | |
| General | 5.574 | .184 | 263 | 5.454 | .165 | 234 | 5.405 | .114 | 223 |
| Specific High | 5.485 | .189 | 241 | 5.393 | .231 | 220 | 5.314 | .238 | 203 |
| Specific Low | 5.542 | .256 | 255 | 5.450 | .213 | 233 | 5.344 | .257 | 209 |
| Music | | | | | | | | | |
| General | 5.406 | .220 | 223 | 5.432 | .229 | 229 | 5.398 | .231 | 221 |
| Specific High | 5.109 | .303 | 166 | 5.170 | .257 | 176 | 5.082 | .269 | 161 |
| Specific Low | 5.366 | .192 | 214 | 5.359 | .284 | 212 | 5.256 | .259 | 192 |

**Second Reading**

| Group | High | | | Intermediate | | | Low | | |
|---|---|---|---|---|---|---|---|---|---|
| | $\bar{X}$ | SD | Geo $\bar{X}$ | $\bar{X}$ | SD | Geo $\bar{X}$ | $\bar{X}$ | SD | Geo $\bar{X}$ |
| Physics | | | | | | | | | |
| General | 5.818 | .210 | 336 | 5.805 | .218 | 332 | 5.730 | .184 | 308 |
| Specific High | 5.769 | .210 | 320 | 5.648 | .191 | 284 | 5.736 | .280 | 310 |
| Specific Low | 5.735 | .136 | 309 | 5.664 | .253 | 288 | 5.567 | .190 | 262 |
| Music | | | | | | | | | |
| General | 5.558 | .167 | 259 | 5.506 | .211 | 246 | 5.522 | .300 | 250 |
| Specific High | 5.416 | .331 | 225 | 5.382 | .394 | 218 | 5.402 | .381 | 222 |
| Specific Low | 5.588 | .209 | 267 | 5.698 | .286 | 298 | 5.666 | .236 | 289 |

Note. The logarithm of the geometric mean of a set of positive numbers is the arithmetic mean of the logarithms of the numbers. It has been included to allow interpretation of the data on the same scale as the raw data.

TABLE 4

Means, Standard Deviations and Geometric Means of the Transformed (LN X) Reading Rates (WPM) for the Notation Text By Reading, Content Structure, Group and Instructional Condition

First Reading

| Group | High | | | Intermediate | | | Low | | |
|---|---|---|---|---|---|---|---|---|---|
| | $\bar{X}$ | SD | Geo $\bar{X}$ | $\bar{X}$ | SD | Geo $\bar{X}$ | $\bar{X}$ | SD | Geo $\bar{X}$ |
| Physics | | | | | | | | | |
| General | 5.456 | .200 | 234 | 5.440 | .235 | 230 | 5.412 | .212 | 224 |
| Specific High | 5.395 | .232 | 220 | 5.386 | .151 | 218 | 5.356 | .260 | 212 |
| Specific Low | 5.388 | .239 | 219 | 5.321 | .238 | 205 | 5.342 | .257 | 209 |
| Music | | | | | | | | | |
| General | 5.544 | .191 | 256 | 5.481 | .151 | 240 | 5.426 | .160 | 227 |
| Specific High | 5.470 | .194 | 237 | 5.359 | .191 | 212 | 5.292 | .212 | 199 |
| Specific Low | 5.495 | .249 | 244 | 5.415 | .198 | 225 | 5.324 | .218 | 205 |

Second Reading

| Group | High | | | Intermediate | | | Low | | |
|---|---|---|---|---|---|---|---|---|---|
| | $\bar{X}$ | SD | Geo $\bar{X}$ | $\bar{X}$ | SD | Geo $\bar{X}$ | $\bar{X}$ | SD | Geo $\bar{X}$ |
| Physics | | | | | | | | | |
| General | 5.744 | .285 | 312 | 5.630 | .215 | 279 | 5.637 | .250 | 281 |
| Specific High | 5.686 | .184 | 295 | 5.650 | .268 | 284 | 5.623 | .212 | 277 |
| Specific Low | 5.676 | .290 | 292 | 5.627 | .308 | 278 | 5.568 | .238 | 262 |
| Music | | | | | | | | | |
| General | 5.842 | .169 | 345 | 5.713 | .157 | 303 | 5.688 | .200 | 295 |
| Specific High | 5.729 | .291 | 308 | 5.668 | .300 | 290 | 5.657 | .258 | 286 |
| Specific Low | 5.864 | .341 | 352 | 5.700 | .292 | 299 | 5.746 | .281 | 313 |

Note. The logarithm of the geometric mean of a set of positive numbers is the arithmetic mean of the logarithms of the numbers. It has been included to allow interpretation of the data on the same scale as the raw data.

TABLE 5

Means, Standard Deviations and Geometric Means of the Transformed (LN X) Reading Rates (WPM)for the Parakeet Text By Reading, Content Structure, Group and Instructional Condition

| Group | First Reading | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | High | | | Intermediate | | | Low | | |
| | $\bar{X}$ | SD | Geo $\bar{X}$ | $\bar{X}$ | SD | Geo $\bar{X}$ | $\bar{X}$ | SD | Geo $\bar{X}$ |
| Physics | | | | | | | | | |
| General | 5.655 | .270 | 286 | 5.426 | .244 | 227 | 5.410 | .226 | 224 |
| Specific High | 5.685 | .133 | 294 | 5.483 | .203 | 240 | 5.467 | .199 | 237 |
| Specific Low | 5.705 | .278 | 300 | 5.516 | .237 | 249 | 5.485 | .273 | 241 |
| Music | | | | | | | | | |
| General | 5.770 | .156 | 321 | 5.549 | .172 | 257 | 5.560 | .146 | 260 |
| Specific High | 5.598 | .261 | 270 | 5.407 | .222 | 223 | 5.377 | .239 | 216 |
| Specific Low | 5.725 | .169 | 306 | 5.459 | .162 | 235 | 5.473 | .181 | 239 |
| | Second Reading | | | | | | | | |
| | High | | | Intermediate | | | Low | | |
| | X | SD | Geo $\bar{X}$ | $\bar{X}$ | SD | Geo $\bar{X}$ | X | SD | Geo $\bar{X}$ |
| Physics | | | | | | | | | |
| General | 5.992 | .385 | 400 | 5.703 | .315 | 300 | 5.760 | .275 | 317 |
| Specific High | 6.047 | .225 | 423 | 5.797 | .226 | 329 | 5.827 | .303 | 339 |
| Specific Low | 6.113 | .285 | 452 | 5.894 | .273 | 363 | 5.784 | .327 | 325 |
| Music | | | | | | | | | |
| General | 5.975 | .205 | 393 | 5.774 | .134 | 322 | 5.663 | .144 | 288 |
| Specific High | 5.989 | .349 | 399 | 5.724 | .325 | 306 | 5.707 | .314 | 301 |
| Specific Low | 6.213 | .354 | 499 | 5.853 | .205 | 348 | 5.960 | .276 | 388 |

Note. The logarithm of the geometric mean of a set of positive numbers is the arithmetic mean of the logarithms of the numbers. It has been included to allow interpretation of the data on the same scale as the raw data.

There were no main effects for the between subjects factors of group or instructional condition nor was the group by instructional condition interaction significant. There were significant differences found between the repeated measures. The Laser passage was generally read slower than the Notation passage which was generally read slower than the Parakeet passage ($F=91.22$, $df=2/83$, $p<.0001$) (see Table 6). The rate at which a passage was read the second time through was found to be significantly faster than the first reading ($F=320.13$, $df=1/84$, $p<.0001$) (see Table 7).

Content structure rating was found to be significant ($F=150.67$, $df=2/33$, $p<.0001$). Contrasts between the various levels of content structure rating indicated that sentences located high in the content structure were generally read faster than sentences located at an intermediate position in the content structure. The intermediate sentences in turn were generally read faster than those sentences located low in the content structure (see Table 8). However, these significant effects for the repeated measures must be somewhat qualified as they are involved in several significant interactions.

There was a significant group by text by content structure interaction ($F=12.63$, $df=4/81$, $p<.0001$). While reading the Laser text, the physics group read high content structure sentences on average at a faster rate than intermediate content structure sentences. While reading the same passage, the music group was slower on the average on both types of content structure sentences and did not appear to differentiate with respect to rate between the two types of content structure ratings. However, when reading the musical notation passage, the music group was generally faster on both kinds of content structure ratings and made a greater differentiation between high and intermediate content structure than did the physics group. When reading the Parakeet text both groups on average read high content structure sentences faster than intermediate content structure sentences and each group read sentences in each content structure category at approximately the same rate (see Figure 1).

TABLE 6

Means, Standard Deviations and Geometric Means of the Transformed (LN X) Reading Rates (WPM) By Text

| Laser | | | Notation | | | Parakeet | | |
|---|---|---|---|---|---|---|---|---|
| $\bar{X}$ | SD | Geo $\bar{X}$ | $\bar{X}$ | SD | Geo $\bar{X}$ | $\bar{X}$ | SD | Geo $\bar{X}$ |
| 5.492 | .229 | 243 | 5.549 | .203 | 257 | 5.709 | .214 | 302 |

Note. The logarithm of the geometric mean of a set of positive numbers is the arithmetic mean of the logarithms of the numbers. It has been included to allow interpretation of the data on the same scale as the raw data.

TABLE 7

Means, Standard Deviations and Geometric Means of Transformed (LN X) Reading Rates (WPM) By Reading

| First | | | Second | | |
|---|---|---|---|---|---|
| $\bar{X}$ | SD | Geo $\bar{X}$ | $\bar{X}$ | SD | Geo $\bar{X}$ |
| 5.437 | .187 | 230 | 5.730 | .214 | 308 |

Note. The logarithm of the geometric mean of a set of positive numbers is the arithmetic mean of the logarithms of the numbers. It has been included to allow interpretation of the data on the same scale as the raw data.

TABLE 8

Means, Standard Deviations and Geometric Means of Transformed (LN X) Reading Rates (WPM) By Content Structure

| High | | | Intermediate | | | Low | | |
|---|---|---|---|---|---|---|---|---|
| $\bar{X}$ | SD | Geo $\bar{X}$ | $\bar{X}$ | SD | Geo $\bar{X}$ | $\bar{X}$ | SD | Geo $\bar{X}$ |
| 5.670 | .193 | 290 | 5.554 | .184 | 258 | 5.526 | .191 | 251 |

Note. The logarithm of the geometric mean of a set of positive numbers is the arithmetic mean of the logarithms of the numbers. It has been included to allow interpretation of the data on the same scale as the raw data.

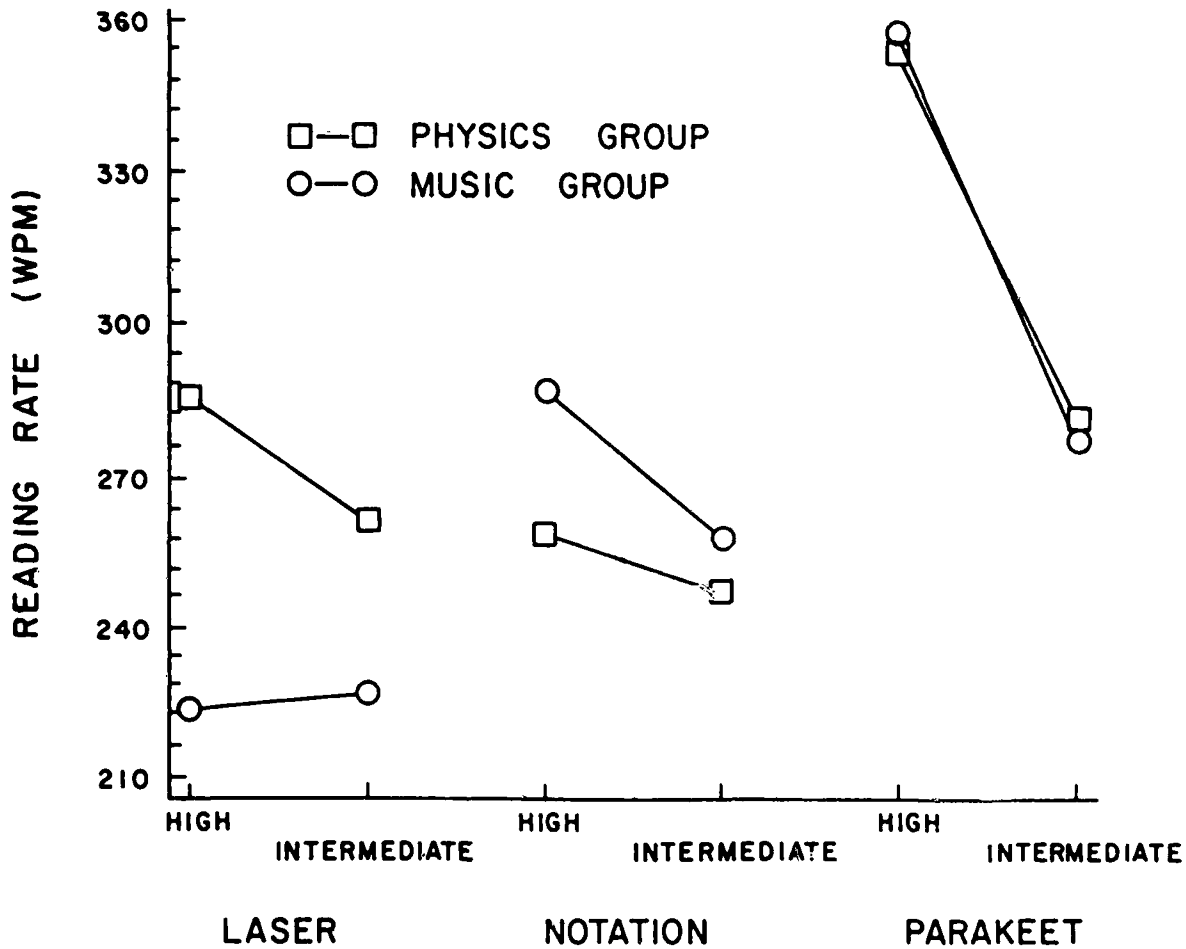


Figure 1. Mean reading rate by group, text, and content structure.

## READING RATE FOR TARGETED SENTENCES

### Description of the Data

The six readin rates of sentences in each passage that had been targeted by either the specific high or specific low instructions were selected from the entire data set of reading rates. This selection occurred after the data had been transformed and corrected for outliers. As with the data set for all sentences, the comparisons of interest were between content structure ratings. Therefore, a mean reading rate was calculated for each content structure category (high and low) for each text (Laser, Notation and Parakeet) for each reading (first and second time) for each subject. This resulted in 12 mean reading rates for each subject.

The means, standard deviations and geometric means of the logarithmic transformed data for each of the three texts are displayed in Tables 9, 10, and 11.

### Analysis

Since these data did not meet the assumptions for the mixed-model univariate analysis of variance, a five-way fixed effects nonorthogonal multivariate analysis of variance was used to analyze these data. Group identification (physics and music) and instructional condition (general, specific high and specific low) were treated as between subjects factors. As indicated by Finn's MULTIVARIANCE program, contrasts between the various cell means were specified as the parameters to be entered into the analysis. Results of the tests for the main effects and interactions are displayed in Appendix J (see Table 2J).

There were no main effects for the between subjects factors of group or instructional condition nor was the group by instructional condition interaction significant. There were significant differences for the repeated measures. Text was significant ($F$=67.41, df=2/83, $p$ <.0001) such that the targeted sentences in the Laser passage were generally read slower than the targeted sentences in the Notation passage which in turn were read slower than the targeted sentences in the Parakeet text (see Table 12). The rate at which targeted sentences were read the second time was significantly faster than the rate at which they were read the first time ($F$=262.91, df=1/84, $p$ <.0001) (see Table 13). Content structure rating was found to be significant ($F$=20.83, df=1/84, $p$ <.0001). Contrasts between the various levels of content structure rating indicated that targeted sentences located high in the content structure were generally read faster than targeted sentences located low in the content structure (see Table 14). Again, these significant effects for the repeated measures must be qualified as they are involved in several significant interactions.

TABLE 9

Means, Standard Deviations and Geometric Means of the Transformed (LN X) Reading Rates (WPM) for the Targeted Sentences in the Laser Text By Reading, Content Structure, Group and Instructional Condition

First Reading

| Group | High $\bar{X}$ | High SD | High Geo $\bar{X}$ | Low $\bar{X}$ | Low SD | Low Geo $\bar{X}$ |
|---|---|---|---|---|---|---|
| Physics | | | | | | |
| General | 5.455 | .238 | 234 | 5.461 | .139 | 235 |
| Specific High | 5.339 | .157 | 208 | 5.415 | .271 | 225 |
| Specific Low | 5.464 | .259 | 236 | 5.354 | .260 | 211 |
| Music | | | | | | |
| General | 5.415 | .217 | 225 | 5.420 | .265 | 226 |
| Specific High | 5.139 | .338 | 171 | 5.111 | .314 | 166 |
| Specific Low | 5.405 | .299 | 222 | 5.298 | .320 | 200 |

Second Reading

| Group | High $\bar{X}$ | High SD | High Geo $\bar{X}$ | Low $\bar{X}$ | Low SD | Low Geo $\bar{X}$ |
|---|---|---|---|---|---|---|
| Physics | | | | | | |
| General | 5.645 | .251 | 283 | 5.856 | .222 | 349 |
| Specific High | 5.621 | .221 | 276 | 5.840 | 294 | 344 |
| Specific Low | 5.582 | .183 | 266 | 5.623 | .191 | 277 |
| Music | | | | | | |
| General | 5.508 | .206 | 247 | 5.507 | .226 | 246 |
| Specific High | 5.386 | .300 | 218 | 5.451 | .340 | 233 |
| Specific Low | 5.486 | .225 | 241 | 5.668 | .310 | 289 |

Note. The logarithm of the geometric mean of a set of positive numbers is the arithmetic mean of the logarithms of the numbers. It has been included to allow interpretation of the data on the same scale as the raw data.

TABLE 10

Means, Standard Deviations and Geometric Means of the Transformed (LN X) Reading Rates (WPM) for the Targeted Sentences in the Notation Text By Reading, Content Structure, Group and Instructional Condition

**First Reading**

| Group | High $\overline{X}$ | High SD | High Geo $\overline{X}$ | Low $\overline{X}$ | Low SD | Low Geo $\overline{X}$ |
|---|---|---|---|---|---|---|
| Physics | | | | | | |
| General | 5.510 | .267 | 247 | 5.477 | .268 | 239 |
| Specific High | 5.375 | .286 | 216 | 5.418 | .297 | 225 |
| Specific Low | 5.445 | .274 | 231 | 5.406 | .287 | 223 |
| Music | | | | | | |
| General | 5.517 | .298 | 249 | 5.534 | .164 | 253 |
| Specific High | 5.457 | .224 | 234 | 5.427 | .245 | 227 |
| Specific Low | 5.493 | .254 | 243 | 5.450 | .192 | 233 |

**Second Reading**

| Group | High $\overline{X}$ | High SD | High Geo $\overline{X}$ | Low $\overline{X}$ | Low SD | Low Geo $\overline{X}$ |
|---|---|---|---|---|---|---|
| Physics | | | | | | |
| General | 5.805 | .253 | 332 | 5.811 | .268 | 334 |
| Specific High | 5.643 | .239 | 282 | 5.778 | .263 | 323 |
| Specific Low | 5.715 | .347 | 304 | 5.680 | .302 | 293 |
| Music | | | | | | |
| General | 5.802 | .229 | 331 | 5.990 | .339 | 399 |
| Specific High | 5.691 | .335 | 296 | 5.914 | .242 | 370 |
| Specific Low | 5.879 | .367 | 357 | 5.844 | .416 | 345 |

Note. The logarithm of the geometric mean of a set of positive numbers is the arithmetic mean of the logarithms of the numbers. It has been included to allow interpretation of the data on the same scale as the raw data.

TABLE 11

Means, Standard Deviations and Geometric Means of the Transformed (LN X) Reading Rates (WPM) for the Targeted Sentences in the Parakeet Text By Reading, Content Structure, Group and Instructional Condition

| Group | First Reading | | | | | |
|---|---|---|---|---|---|---|
| | High | | | Low | | |
| | $\bar{X}$ | SD | Geo $\bar{X}$ | $\bar{X}$ | SD | Geo $\bar{X}$ |
| Physics | | | | | | |
| General | 5.634 | .290 | 280 | 5.354 | .221 | 211 |
| Specific High | 5.577 | .152 | 264 | 5.456 | .276 | 234 |
| Specific Low | 5.571 | .324 | 263 | 5.378 | .289 | 217 |
| Music | | | | | | |
| General | 5.622 | .179 | 276 | 5.508 | .169 | 247 |
| Specific High | 5.533 | .272 | 253 | 5.313 | .263 | 203 |
| Specific Low | 5.700 | .186 | 299 | 5.339 | .218 | 208 |
| | Second Reading | | | | | |
| | High | | | Low | | |
| | $\bar{X}$ | SD | Geo $\bar{X}$ | $\bar{X}$ | SD | Geo $\bar{X}$ |
| Physics | | | | | | |
| General | 6.002 | .356 | 404 | 5.805 | .353 | 332 |
| Specific High | 5.965 | .217 | 390 | 5.798 | .302 | 330 |
| Specific Low | 6.068 | .321 | 432 | 5.770 | .384 | 321 |
| Music | | | | | | |
| General | 5.851 | .253 | 348 | 5.649 | .156 | 284 |
| Specific High | 5.923 | .373 | 374 | 5.598 | .381 | 270 |
| Specific Low | 6.179 | .331 | 482 | 5.935 | .344 | 378 |

Note. The logarithm of the geometric mean of a set of positive numbers is the arithmetic mean of the logarithms of the numbers. It has been included to allow interpretation of the data on the same scale as the raw data.

TABLE 12

Means, Standard Deviations and Geometric Means of the Transformed (LN X) Reading Rates (WPM) for Targeted Sentences By Text

| Laser | | | Notation | | | Parakeet | | |
|---|---|---|---|---|---|---|---|---|
| $\bar{X}$ | SD | Geo $\bar{X}$ | $\bar{X}$ | SD | Geo $\bar{X}$ | $\bar{X}$ | SD | Geo $\bar{X}$ |
| 5.477 | .223 | 239 | 5.627 | .226 | 278 | 5.689 | .229 | 296 |

Note. The logarithm of the geometric mean of a set of positive numbers is the arithmetic mean of the logarithms of the numbers. It has been included to allow interpretation of the data on the same scale as the raw data.

TABLE 13

Means, Standard Deviations and Geometric Means of the Transformed (LN X) Reading Rates (WPM) for Targeted Sentences By Reading

| First | | | Second | | |
|---|---|---|---|---|---|
| $\bar{X}$ | SD | Geo $\bar{X}$ | $\bar{X}$ | SD | Geo $\bar{X}$ |
| 5.438 | .200 | 230 | 5.757 | .222 | 317 |

Note. The logarithm of the geometric mean of a set of positive numbers is the arithmetic mean of the logarithms of the numbers. It has been included to allow interpretation of the data on the same scale as the raw data.

TABLE 14

Means, Standard Deviations and Geometric Means of Transformed (LN X) Reading Rates (WPM) for Targeted Sentences By Content Structure

| High | | | Low | | |
|---|---|---|---|---|---|
| $\bar{X}$ | SD | Geo $\bar{X}$ | $\bar{X}$ | SD | Geo $\bar{X}$ |
| 5.622 | .195 | 277 | 5.573 | .199 | 263 |

Note. The logarithm of the geometric mean of a set of positive numbers is the arithmetic mean of the logarithms of the numbers. It has been included to allow interpretation of the data on the same scale as the raw data.

The group by text interaction was significant ($F$=14.00, df=2/83, $p$ <.0001). Contrasts between cell means revealed that while the physics group read the Laser text at a faster rate than the music group did, the groups reversed their positions when reading the Notation text; that is, the music group read the Notation text at a faster rate than did the physics group. Additionally, when reading the Parakeet text the two groups did not differ (see Figure 2).

The instructions by content structure interaction was also significant ($F$=6.73, df=2/84, $p$ <.002). The group that received instructions to pay particular attention to low content information read that information much slower relative to the rate at which they read sentences containing high content information. Additionally, those who received instructions to pay particular attention to high content information read sentences containing both high and low content information at a relatively slow rate (see Figure 3).

## FREQUENCY OF ERRORS ON THE RECOGNITION MEMORY TESTS

### Description of Data

The total number of errors made for each content structure category (high, intermediate and low) for each recognition test (Laser, Notation and Parakeet) was calculated for each subject. Therefore, there were nine error frequencies for each subject. A square root transformation was applied to the frequencies in order to minimize violations of the assumption of normality and homogeneity of variances underlying the analysis of variance model (Kruskal, 1968; Olson, 1976; Winer, 1971).

The means, standard deviations and squared means of the transformed data (SQRT X + 0.5) for each of the three texts are displayed in Tables 15, 16, and 17.

### Analysis

Since the appropriate assumptions were met, the mixed-model univariate analysis of variance was used to test this data set. Group identification (physics and music) and instructional condition (general, specific high and specific low) were treated as between subjects factors. Text (Laser, Notation, and Parakeet) and content structure rating (high, intermediate, and low) were repeated measures. As indicated by Finn's program, contrasts between the various cell means were specified as the parameters to be entered into the analysis. Results of the tests for the main effects and interactions are displayed in Appendix J (see Table 3J).

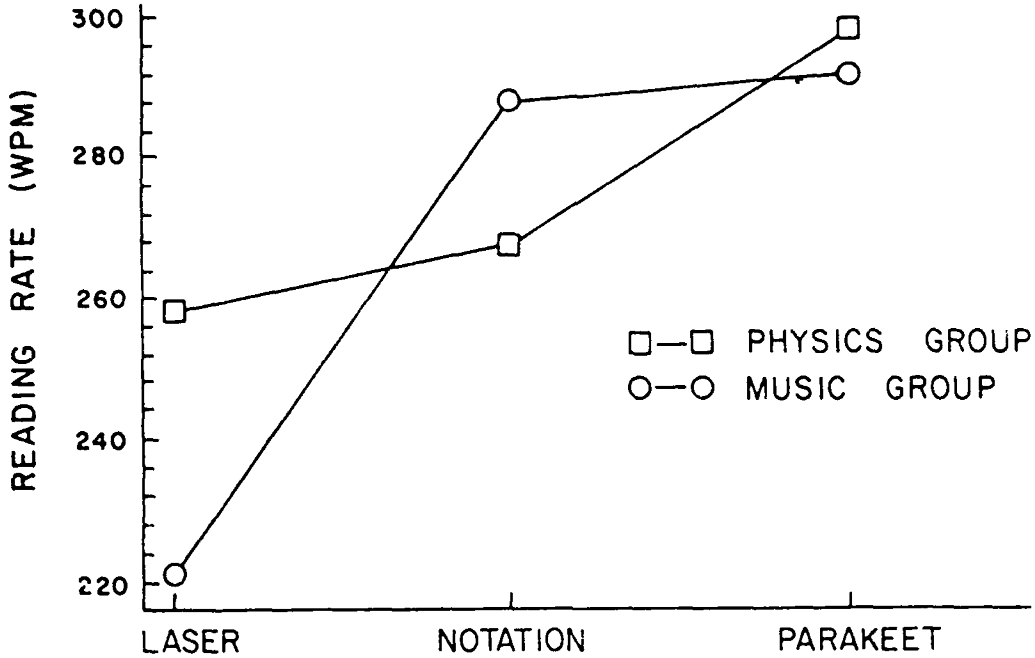


Figure 2. Mean reading rate for targeted sentences by group and text.

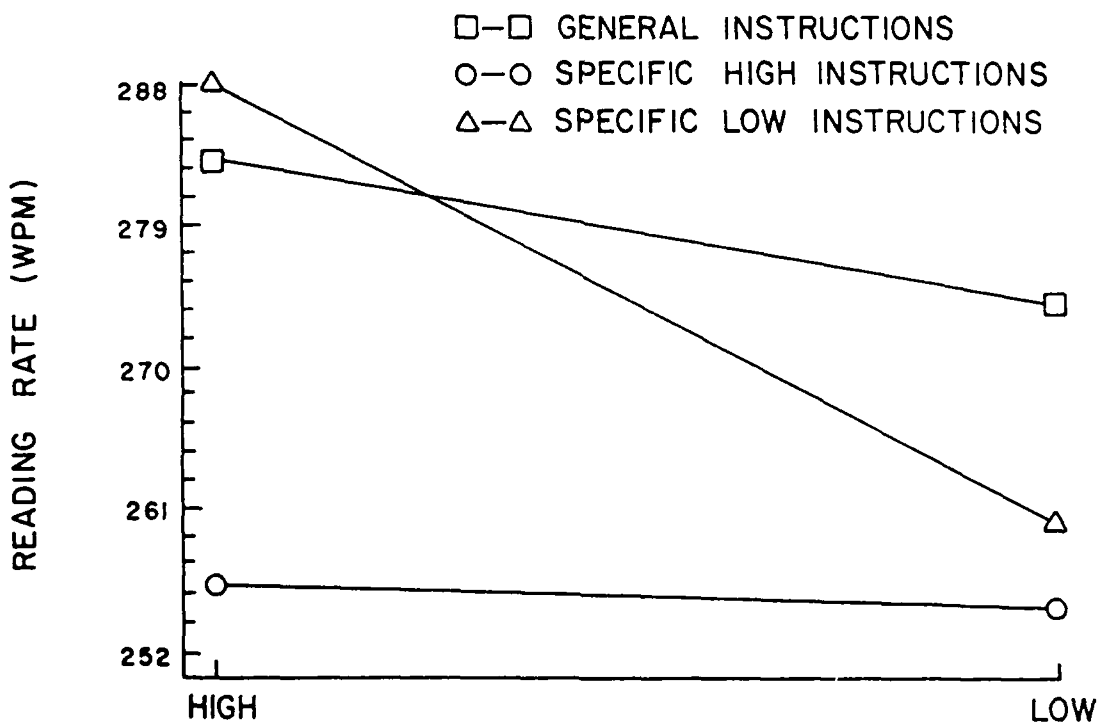


Figure 3. Mean reading rate for targeted sentences by instructional condition and content structure.

TABLE 15

Means, Standard Deviations and the Squared Means of the Transformed (SQRT X + 0.5) Error Frequencies on the Recognition Memory Tests for the Laser Text By Group, Instructional Condition, Reading and Content Structure

| Group | High | | | Intermediate | | | Low | | |
|---|---|---|---|---|---|---|---|---|---|
| | $\bar{X}$ | SD | $\bar{X}^2$ | $\bar{X}$ | SD | $\bar{X}^2$ | $\bar{X}$ | SD | $\bar{X}^2$ |
| **Physics** | | | | | | | | | |
| General | .996 | .340 | .99 | 1.400 | .282 | 1.96 | 1.093 | 0.429 | 1.19 |
| Specific High | 1.039 | .405 | 1.08 | 1.298 | .295 | 1.69 | 1.018 | 0.263 | 1.04 |
| Specific Low | 1.041 | .297 | 1.08 | 1.264 | .332 | 1.60 | 1.182 | 0.333 | 1.40 |
| **Music** | | | | | | | | | |
| General | 1.216 | .306 | 1.48 | 1.480 | .434 | 2.19 | 1.249 | 0.389 | 1.56 |
| Specific High | 1.065 | .325 | 1.13 | 1.341 | .329 | 1.80 | 1.462 | 0.321 | 2.14 |
| Specific Low | 1.147 | .354 | 1.32 | 1.479 | .349 | 2.19 | 1.307 | 0.367 | 1.71 |

Note. The inverse of the transformed mean has been included to allow interpretation of the data on the same scale as the raw data.

TABLE 16

Means, Standard Deviations and the Squared Means of the Transformed (SQRT X + 0.5) Error Frequencies on the Recognition Memory Tests for the Notation Text By Group, Instructional Condition, Reading and Content Structure

| Group | High | | | Intermediate | | | Low | | |
|---|---|---|---|---|---|---|---|---|---|
| | $\overline{X}$ | SD | $\overline{X}^2$ | $\overline{X}$ | SD | $\overline{X}^2$ | $\overline{X}$ | SD | $\overline{X}^2$ |
| Physics | | | | | | | | | |
| General | 1.089 | .350 | 1.19 | 1.528 | .325 | 2.33 | 1.333 | .247 | 1.78 |
| Specific High | 1.054 | .361 | 1.11 | 1.436 | .336 | 2.06 | 1.285 | .227 | 1.65 |
| Specific Low | 1.265 | .421 | 1.60 | 1.490 | .397 | 2.22 | 1.145 | .244 | 1.31 |
| Music | | | | | | | | | |
| General | 1.216 | .306 | 1.48 | 1.307 | .367 | 1.71 | 1.193 | .289 | 1.42 |
| Specific High | 1.089 | .350 | 1.19 | 1.320 | .163 | 1.74 | 1.270 | .305 | 1.61 |
| Specific Low | 1.085 | .364 | 1.18 | 1.357 | .253 | 1.84 | 1.123 | .335 | 1.26 |

*Note.* The inverse of the transformed mean has been included to allow interpretation of the data on the same scale as the raw data.

TABLE 17

Means, Standard Deviations and the Squared Means of the Transformed (SQRT X + 0.5) Error Frequencies on the Recognition Memory Tests for the Parakeet Text By Group, Instructional Condition, Reading and Content Structure

| Group | High | | | Intermediate | | | Low | | |
|---|---|---|---|---|---|---|---|---|---|
| | $\bar{X}$ | SD | $\bar{X}^2$ | $\bar{X}$ | SD | $\bar{X}^2$ | $\bar{X}$ | SD | $\bar{X}^2$ |
| Physics | | | | | | | | | |
| General | 1.041 | .297 | 1.08 | 1.236 | .338 | 1.53 | .938 | .305 | .88 |
| Specific High | .903 | .300 | .82 | 1.227 | .256 | 1.51 | 1.100 | .312 | 1.21 |
| Specific Low | .957 | .354 | .92 | 1.443 | .302 | 2.08 | .914 | .263 | .84 |
| Music | | | | | | | | | |
| General | 1.076 | .285 | 1.16 | 1.307 | .367 | 1.71 | 1.065 | .325 | 1.13 |
| Specific High | 1.123 | .335 | 1.26 | 1.320 | .163 | 1.74 | .893 | .332 | .80 |
| Specific Low | 1.007 | .304 | 1.01 | 1.275 | .285 | 1.62 | .834 | .275 | .70 |

Note. The inverse of the transformed mean has been included to allow interpretation of the data on the same scale as the raw data.

There were no significant main effects for the between subjects factors of group or instructional condition. The repeated measure of text was significant ($F=11.06$, $df=2/83$, $p<.0001$) such that fewer errors were made on the Parakeet text than on either the Laser or Notation text (see Table 18). Content structure was significant ($F=54.39$, $df=2/83$, $p<.0001$). Contrasts between cell means revealed that significantly fewer errors were made on sentences that contained information high in the content structure than on sentences that contained information located *intermediate in the* content structure (see Table 19).

The main effect for text must be somewhat qualified as it was involved in a significant group by text interaction ($F=10.79$, $df=2/83$, $p<.0001$). Contrasts between cell means showed that the music group made more errors on the Laser text than did the physics group, while their positions were reversed on the Notation text. The groups did not differ in the number of errors made on the Parakeet text (see Figure 4).

## FREQUENCY OF ERRORS FOR TARGETED SENTENCES IN THE RECOGNITION MEMORY TESTS

### Description of the Data

Errors made on the six sentences in each passage that had been targeted by either the specific high or specific low instructions were selected for the analyses. A total number of errors for each content structure category (high and low) for each text (Laser, Notation and Parakeet) was calculated. Therefore, there were six error frequencies for each subject. A square root transformation was applied to the frequencies in order to minimize violations of the assumptions of normality and homogeneity of variances underlying the analysis of variance model (Kruskal, 1968; Olson, 1976; Winer, 1971).

The means, standard deviations and squared means of the transformed data (SQRT X + 0.5) for each of the three texts are displayed in Tables 20, 21, and 22.

### Analysis

Since the appropriate assumptions were met, the mixed-model univariate analysis of variance was used to test this data set. Group identification (physics and music) and instructional condition (general, specific high and specific low) were treated as between subject factors. Text (Laser, Notation, and Parakeet) and content structure rating (high and low) were repeated measures. As indicated by Finn's program, contrasts between the various cell means were specified as the parameters to be entered into the analysis. Results of the tests for the main effects and interactions are displayed in Appendix J (see Table 4J).

TABLE 18

Means, Standard Deviations and Squared Means of the Transformed (SQRT X + 0.5) Error Frequencies By Text

| Laser | | | Notation | | | Parakeet | | |
|---|---|---|---|---|---|---|---|---|
| $\overline{X}$ | SD | $3(\overline{X})^2$ | $\overline{X}$ | SD | $3(\overline{X})^2$ | $\overline{X}$ | SD | $3(\overline{X})^2$ |
| 1.227 | .240 | 4.51 | 1.255 | .209 | 4.72 | 1.092 | .166 | 3.58 |

Note. The inverse of the transformed mean has been included to allow interpretation of the data on the same scale as the raw data.

TABLE 19

*Means, Standard Deviations and Squared Means of the* Transformed (SQRT X + 0.5) Error Frequencies By Content Structure

| High | | | Intermediate | | | Low | | |
|---|---|---|---|---|---|---|---|---|
| $\overline{X}$ | SD | $3(\overline{X})^2$ | $\overline{X}$ | SD | $3(\overline{X})^2$ | $\overline{X}$ | SD | $3(\overline{X})^2$ |
| 1.078 | .224 | 3.49 | 1.361 | .173 | 5.56 | 1.134 | .193 | 3.85 |

Note. The inverse of the transformed mean has been included to allow interpretation of the data on the same scale as the raw data.

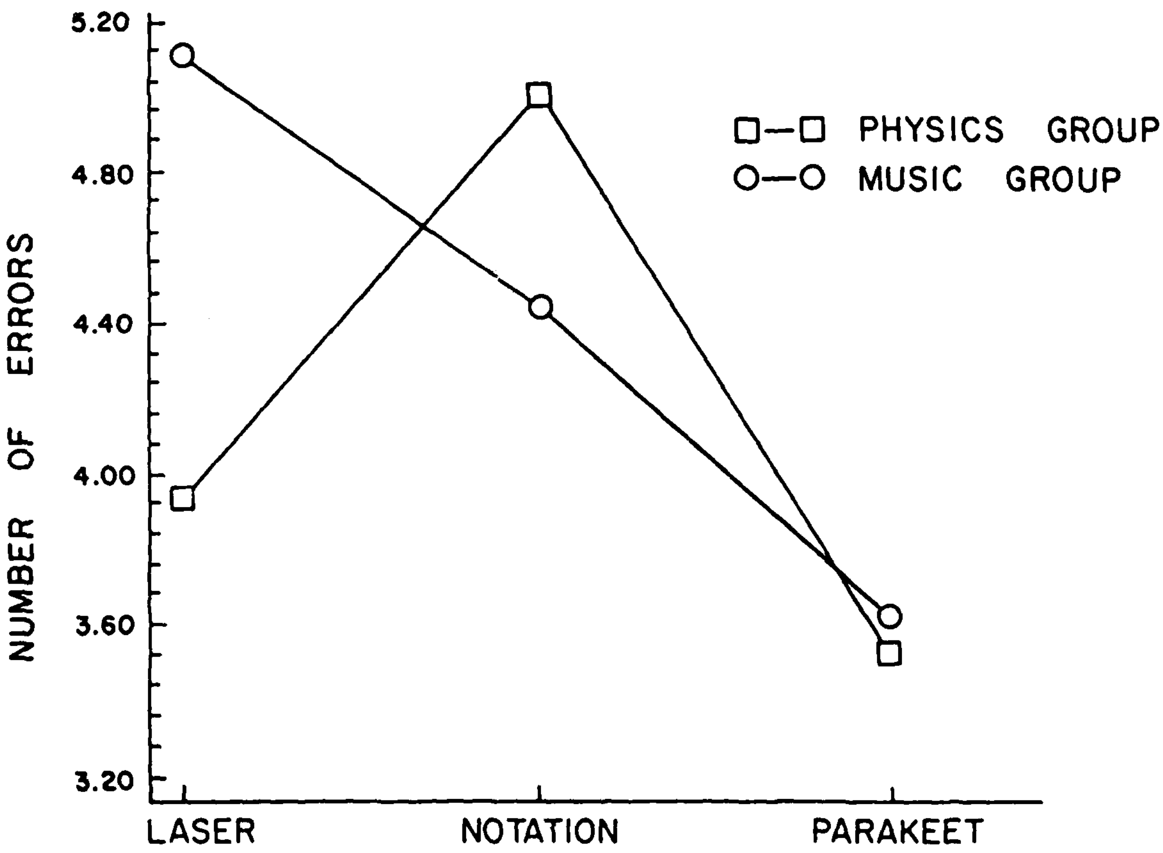


Figure 4. Number of errors on the recognition memory tests by group and text.

TABLE 20

Means, Standard Deviations and the Squared Means of the Transformed (SQRT X + 0.5) Error Frequencies on the Targeted Sentences in the Recognition Memory Tests for the Laser Text By Content Structure, Group and Instructional Condition

| Group | High | | | Intermediate | | |
|---|---|---|---|---|---|---|
| | $\bar{X}$ | SD | $\bar{X}^2$ | $\bar{X}$ | SD | $\bar{X}^2$ |
| Physics | | | | | | |
| General | .972 | .306 | .95 | .996 | .340 | .99 |
| Specific High | .985 | .372 | .97 | .983 | .267 | .97 |
| Specific Low | .938 | .305 | .88 | 1.018 | .263 | 1.04 |
| Music | | | | | | |
| General | 1.110 | .268 | 1.23 | 1.206 | .349 | 1.45 |
| Specific High | 1.065 | .325 | 1.13 | 1.419 | .305 | 2.01 |
| Specific Low | 1.041 | .297 | 1.08 | 1.145 | .244 | 1.31 |

*Note*. The inverse of the transformed mean has been included to allow interpretation of the data on the same scale as the raw data.

TABLE 21

Means, Standard Deviations and the Squared Means of the Transformed (SQRT X + 0.5) Error Frequencies on the Targeted Sentences in the Recognition Memory Tests for the Notation Text By Content Structure, Group and Instructional Condition

| Group | High | | | Intermediate | | |
|---|---|---|---|---|---|---|
| | $\bar{X}$ | SD | $\bar{X}^2$ | $\bar{X}$ | SD | $\bar{X}^2$ |
| Physics | | | | | | |
| General | .996 | .340 | .99 | .972 | .307 | .95 |
| Specific High | .951 | .372 | .90 | .962 | .341 | .92 |
| Specific Low | 1.177 | .349 | 1.39 | .811 | .214 | .66 |
| Music | | | | | | |
| General | 1.158 | .315 | 1.34 | .914 | .263 | .84 |
| Specific High | 1.089 | .350 | 1.19 | .972 | .307 | .95 |
| Specific Low | 1.065 | .325 | 1.13 | .914 | .263 | .84 |

*Note.* The inverse of the transformed mean has been included to allow interpretation of the data on the same scale as the raw data.

TABLE 22

Means, Standard Deviations and the Squared Means of the Transformed (SQRT X + 0.5) Error Frequencies on the Targeted Sentences in the Recognition Memory Tests for the Parakeet Text By Content Structure, Group and Instructional Condition

| Group | High | | | Intermediate | | |
|---|---|---|---|---|---|---|
| | $\bar{X}$ | SD | $\bar{X}^2$ | $\bar{X}$ | SD | $\bar{X}^2$ |
| Physics | | | | | | |
| General | .983 | .267 | .97 | .914 | .263 | .84 |
| Specific High | .880 | .253 | .77 | .996 | .340 | .99 |
| Specific Low | .834 | .275 | .70 | .880 | .253 | .77 |
| Music | | | | | | |
| General | .949 | .267 | .90 | .983 | .267 | .97 |
| Specific High | .972 | .307 | .95 | .811 | .214 | .66 |
| Specific Low | .949 | .267 | .90 | .776 | .182 | .60 |

*Note*. The inverse of the transformed mean has been included to allow interpretation of the data on the same scale as the raw data.

There were no significant main effects for the between subjects factors of group or instructional condition. The repeated measure text was significant ($F$=16.20, df=2/83, $p$ <.0001) such that fewer errors were made on the Parakeet text than on either the Laser text or Notation text (see Table 23). This result must be qualified as it was involved in a significant text by content structure interaction ($F$=12.33, df=2/83, $p$ <.0001). Contrasts between cell means showed that fewer errors were made on targeted sentences high in the content structure in the Laser text than in the Notation text, while fewer errors were made on targeted sentences low in the content structure in the Notation text (see Figure 5).

There was also a group by text interaction ($F$=7.10, df=2/83, $p$ <.0011). Contrasts between cell means revealed that music majors made significantly more errors on the Laser text than did the physics majors, while the number of errors made on the Parakeet text did not differ between the two groups (see Figure 6).

TABLE 23

Means, Standard Deviations and Squared Means of the Transformed (SQRT X + 0.5) Error Frequencies on Targeted Sentences By Text

| Laser | | | Notation | | | Parakeet | | |
|---|---|---|---|---|---|---|---|---|
| $\bar{X}$ | SD | $2(\bar{X})^2$ | $\bar{X}$ | SD | $2(\bar{X})^2$ | $\bar{X}$ | SD | $2(\bar{X})^2$ |
| 1.073 | .246 | 2.30 | .999 | .219 | 1.99 | .911 | .194 | 1.66 |

Note. The inverse of the transformed mean has been included to allow interpretation of the data on the same scale as the raw data.

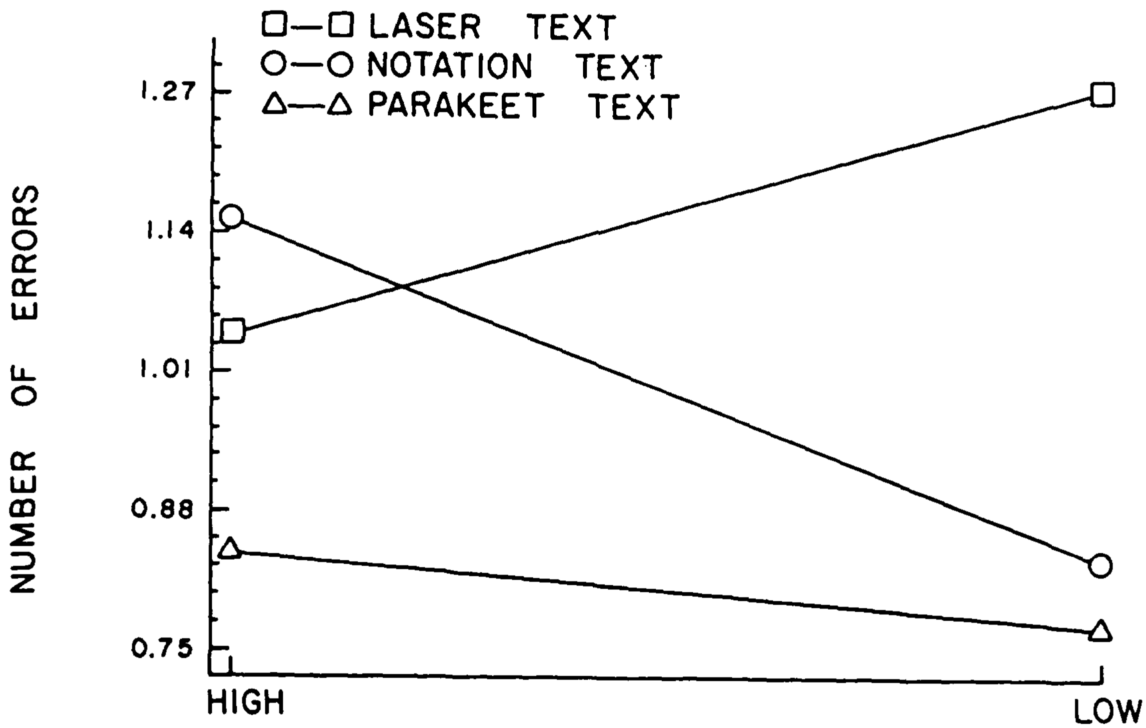


Figure 5. Number of errors on targeted sentences in recognition memory tests by text and content structure.

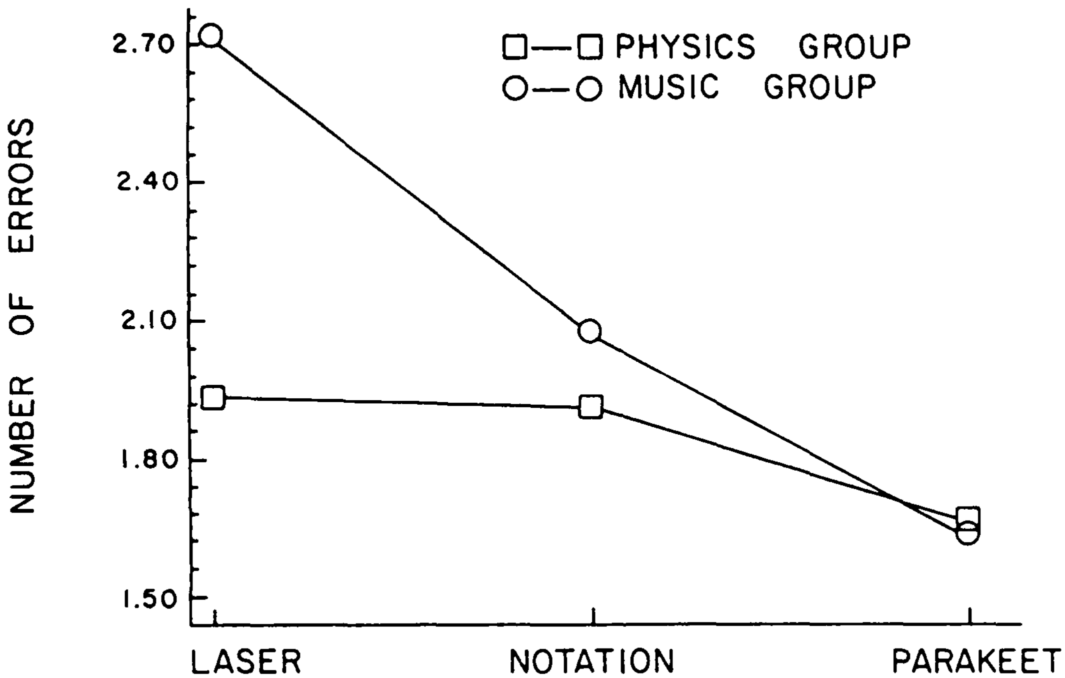


Figure 6. Number of errors on targeted sentences in recognition memory tests by group and text.

# CHAPTER IV

# DISCUSSION

## RELATIONSHIP BETWEEN RESULTS AND HYPOTHESES

The results of this investigation will first be discussed as they relate to each hypothesis listed in the introduction. Further interpretations of these results will be given in the next section. The first hypothesis stated that prior knowledge of a topic could be used to differentiate information from the various levels of the content structure of the text. Furthermore, according to this prediction, this differentiation was expected to be exhibited in differing amounts of attention to sentences depending upon their height in the content structure of the text. This prediction was confirmed, in that, high content structure sentences were read at a faster rate on average than either intermediate or low content structure sentences by the group whose background knowledge was related to the text topic.

When the group did not have specialized background knowledge corresponding to the text content, this differentiation of attention to information was either not apparent or much less pronounced. Subjects who demonstrated a lack of knowledge about a discourse topic were relatively insensitive to the text structure. On the control text both groups read high content structure information at a faster rate than either intermediate or low content structure information and their rates at each of these levels were almost identical. Although none of the subjects in this investigation were known to possess specialized "expert" knowledge of parakeets, it would be reasonable to assume that they did share a common general knowledge about pets and birds. This commonly shared background knowledge could explain why both groups read the parakeet text in a manner similar to the way they read texts for which they exhibited specialized background knowledge of the discourse topic. If this assumption is accepted, then it appears that detection of text structure depends in part upon what the reader already knows about the discourse topic.

The second hypothesis suggested that specialized background knowledge could be used to direct attention to information in text that had been designated as critical by the purpose-setting instructions. According to this prediction, the group whose background corresponded to the content of the text would be better able to detect, and therefore, devote more attention to sentences whose information had been targeted for later testing. This prediction was not confirmed, as the reading rate of targeted sentences did not differ as a function of text and content structure between the background knowledge groups in the different instructional conditions. There is always the possibility that the failure to find this interaction was a function of the instructions used to direct attention. However, that does not seem likely as the instructions did seem

to have an effect across both groups and all texts on the reading rates for the targeted sentences. Subjects who received instructions to learn certain topics that were high in the content structure, read sentences containing those topics at a slower rate than the other two instructional groups. Subjects who received instructions to learn topics that were low in the content structure (a) read sentences containing that information at a slower rate than the general instructional group who were not given specific information to learn, and (b) read sentences containing non-targeted information high in the content structure at a faster rate than the general instructional group. This pattern of results would seem to indicate that background knowledge does not appear to be necessary in order to utilize instructions as given here to direct attention to specific information.

It should be noted that these purpose-setting instructions did not influence attention to other sentences within a given content structure level. On the reading rates for all sentences there was no difference between the instructional groups for sentence reading rates at the various content structure levels. That is, subjects in this investigation did not pay more attention to other sentences at the same content structure level as those sentences that had been targeted. This is in contrast to the results reported by Reynolds, Standiford, and Anderson (1979) who found that instructions to learn specific information generalized to other information in the same category. On the basis of findings from this research it would appear that this generalizability of instructions was category specific to the semantic category and independent of text structure.

Another finding of particular relevance to this hypothesis was that, although instructions seemed to alter processing by allocating attention to targeted sentences, they did not appear to have a strong effect upon what was later remembered from those sentences. No effects were found on the recognition memory tests as a function of instructional group assignment. This suggests that the relationship between reading rate and memory is not a simple positive linear function.

The third hypothesis was a test of selective attention to text information as a function of height in the content structure. This hypothesis predicted that (a) additional attention would be allocated to information high in the content structure hierarchy as compared to information at lower levels, and (b) this additional attention presumably is used to process that information to a deeper level which would result in better memory for material high in the content structure hierarchy than for information low in the content structure. The results of this investigation did not confirm this position. Rather, sentences containing high content structure information were read at a faster rate on the average than sentences containing intermediate content structure information. Sentences containing intermediate content structure information were in turn read at a faster rate on average than sentences containing low content structure information. This finding is, of course, qualified by the finding that background knowledge seems to be necessary for the detection of content structure as discussed previously.

With respect to the memory measures recognition memory was better for sentences containing high content structure information than for sentences containing intermediate content structure information. These results do not provide any support for an explanation of partial and modified discourse memory that relies upon extra processing to account for better memory. Assuming that content structure and text information are not orthogonal, the pattern of results in this research shows that fewer errors were made on high content structure sentences even though they were read on average at a faster rate than lower content structure sentences.

## GENERAL DISCUSSION

The results of this research serve to clarify the relationships between text structure, background knowledge, and reader's purpose on the processing and memory of connected discourse. It was shown that text structure as defined by Meyer (1975) is not an inherent property of a text that is perceived and processed by all readers the same way. This is not a new argument (Goetz & Armbruster, 1980; Spiro, 1977, 1980). However, this research is the first direct demonstration that sensitivity to the text structure seems to depend in part upon what the reader already knows about the discourse topic.

This research also demonstrated that purpose- or goal-setting instructions to readers appear to alter processing of textual information, since reading rates were slower for sentences containing information that had been targeted for testing. However, this apparent increase in allotted attention, and presumably extra processing, did not seem to result in better memory for that information.

These findings are not the result of a selective attention mechanism which allocates extra processing time to important text elements. The pattern of results in this research indicates that fewer errors were made on high content structure sentences even though they were read on average at a faster rate than lower content structure sentences. This is similar to the finding reported by Graesser, Hoffman and Clark (1980) who correlated mean reading time per sentence and mean recall propositions for narratives. They found a significant negative correlation, $r = -0.87$, suggesting that an increase in reading time is negatively related to accuracy of recall. These findings, of course, do not preclude the possibility of differential processing of discourse information as a function of content structure to account for the findings related to memory for discourse.

With respect to the recognition memory findings, information high in the content structure was remembered better than information intermediate in the content structure. These findings basically agree with data reported on recall of text information as a function of text structure (Meyer, 1975, 1977), in that high content structure information is best recognized. The finding that fewer errors were made on sentences containing low content structure information than sentences containing intermediate content structure information may be a function of the semantic content of the low sentences. Meyer (1975) found that, whereas

recall of information from higher levels of the content structure seemed to be a function of the content structure, recall of information from lower levels of the content structure seemed to be determined by particular aspects of the information contained in those levels. She reported that two kinds of information that seemed to have particular saliency were numbers and sequences of numbers. Inspection of the raw data for errors on the recognition memory test showed that the lowest error rates (2 errors out of a possible 90) were on two low content structure sentences. One contained number information, and the second contained a sequence of letters representing notes of the musical scale. The extremely low number of errors on these sentences may have been due to the saliency of these particular types of information. Therefore, the pattern of recognition memory data found in this investigation appears to agree with the recall findings reported by Meyer.

The relationships demonstrated between these text variables and reader variables support an interactionist view of reading in particular, and discourse processing in general. Reading text involves both conceptually-driven processes as well as data-driven ones. That is, the comprehension of any piece of discourse is dependent upon processes guided by the reader's existing knowledge as well as processes directed by the perceptual input. One possible mechanism by which these conceptually-driven processes might operate is metacognitive in nature. This explanation also rests on the assumptions that (a) high content structure information is more familiar to a reader and may already be encoded in memory at least in part, or (b) that the conceptual base necessary for comprehending high content structure information is more likely to be encoded in memory. Conceivably, as a sentence was read by a subject, a judgment was made by the subject as to the familiarity of the semantic content of that sentence. If the material was judged to be more familiar, then less attention was devoted to it, so that more attention could be devoted to less familiar material. Presumably, more familiar information would be more easily encoded into memory and better remembered despite the relative lack of attention devoted to it. This strategy would have been consistent with the strategy recommended in the instructions to maximize the points earned. This proposed processing mechanism is speculative and, of course, subject to empirical verification.

There is one criticism that could be directed to this investigation as well as to most research paradigms that use connected discourse. The content structure of each of these texts may be confounded with the actual semantic information or material that is located at that level in the content structure. That is, information that is at one level in the content structure of a text is not located at other levels making an independent test of text structure impossible. This is an inherent problem in virtually all investigations using connected discourse. Several researchers (Cirilo & Foss, 1980; Meyer, 1975, 1977) have claimed to resolve this issue by embedding the same target sentence or paragraph in texts where the level of that information varies. However, changing the content structure level of information can change the meaning and interpretation given to the same linguistic input. For example, Cirilo and

Foss used two fairy tales, each of which contained the target sentence, "He could no longer talk at all." In the story where this sentence was high in the story structure the interpretation consistent with the story line is that the main character literally and physically could not produce speech. The interpretation that could be given to that same sentence in a second story where it was low in the story structure, however, could have been figurative. That is, the main character's inability to speak was a temporary and transient loss due to surprise, much like that indicated by the expression "He was struck speechless." It may be that anytime the text structure is changed, the interpretation given to the content may also change. Orthogonal manipulations of semantic content as a function of text structure may be impossible. It may not be possible to separate the information at a specific content structure level from that level. This speculation is supported by the finding in this research that prior knowledge of the discourse topic seems to be necessary to detect content structure. Regardless of whether information and text structure are orthogonal, this possible confound does not severely limit the interpretation of these data. The major conclusions rest upon demonstrated differences between independent groups in the pattern of responding and the relationships between the measured variables.

## RECOMMENDATIONS FOR ADDITIONAL RESEARCH

There were two questions that arose during the course of this research that revolved around methodological issues. The first dealt with verification of the technique used to present the texts to the subjects in this research. The constraints of available technology precluded presenting segments of text larger than a sentence in this research. It should be noted that many studies have been reported recently that have also presented individual text segments sequentially. It is possible that these partial text presentation modes may have disrupted reading processes typically used when entire texts are present. One possible method of measuring amount of attention allocated to different segments of an intact text is through the monitoring of eye movements. If the results of this study could be replicated using an alternative eye movement technology, then the results obtained from a segment-by-segment presentation mode would appear to generalize to cases where the entire text is present for inspection.

A second methodological feature of the present research that should be investigated is the effect of the type of test used. Graesser, Hoffman and Clark (1980) recently reported that reading goals in the form of instructions to study for a specific kind of test influenced the processing of text. In the present investigation recognition memory tests, rather than free recall or cued recall, were used because recognition memory tests appear to be the least affected by retrieval mechanisms. It may be that the reader's expectation for this particular type of test influenced processing strategies used to read these texts. Future research should determine whether the same pattern of results with respect to the rate at which information at different levels of content structure are read is the same when different kinds of memory tests are expected.

With respect to theoretical issues, one of the more intriguing findings in this research was the pattern of average reading rates for sentences at the three content structure levels. That is, sentences containing high content structure information were read on average at a faster rate than sentences containing intermediate content structure information which in turn were read on average at a faster rate than were those containing low content structure information. This direction was not only unexpected, but was in the opposite direction from that predicted by most theories of a selective allocation of attention. Also, these reading rate results correlate negatively with memory for information in the passages read. Since this pattern of results was found across all three texts, it does not appear to be a spurious result. It may be possible that the reading rate results are the function of some characteristics of the information found at the various content structure levels. As suggested earlier in this discussion, high content structure information may be more familiar than lower content structure information. Another possibility is that high content structure information may by definition be more general than lower content structure information. A systematic exploration of the type and kind of information contained at the various levels may serve to explain the somewhat surprising finding that information read at the fastest rate is remembered the best.

While the results of this investigation suggest that processing strategies are affected by various reader and text factors, a more definitive explanation of how encoding processes operate is desirable. There seems to be some consensus that encoding consists of several sub-processes. The relative contribution to reading time of (a) sentence level factors, such as, number of words, number of propositions, word frequency, and syntax, (b) text level factors, such as, genre, content structure, and cohesive relations, and (c) reader factors, such as background knowledge and purpose, could be ascertained. This data could be useful in identifying the various sub-processes and their relationship to one another in comprehension and encoding.

One statistical technique that may prove fruitful in studying these processing questions is a regression approach. Recently, several researchers (Graesser, Hoffman, & Clark, 1980; Kieras, 1981) have reported regressing several measures of text characteristics on reading times for sentences within a text. The advantages of this approach are (a) many more variables can be considered in any one text than can be comfortably handled or manipulated in a factorial design, and (b) the relative contribution of the measured predictors can be determined.

Another question of theoretical interest was raised by the recognition memory results. Extremely low error rates were recorded for several low content structure sentences. As discussed previously, this finding was not inconsistent with other recall data reported by Meyer (1975). Future research should attempt to determine what kinds of information are salient even at the lower levels of a content structure.

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APPENDIX A

TEST OF BACKGROUND KNOWLEDGE

NAME ____________________

DATE ____________________

CODE # __________________

Test of Background Knowledge

Directions: There are two parts to this test. There are 20 questions about topics in physics in one subtest and 20 questions about topics in music in the other subtest. Feel free to answer these questions in any order. Each of the questions or incomplete statements is followed by five suggested answers or completions. Select the one which is best in each case. Record all responses on the answer sheet. If you are not reasonably sure that you know the answer (for example, have narrowed the answer to two out of the five possibilities), you should not guess. Your score will be determined by the number of correct responses minus some fraction of the number wrong. *Therefore, random guessing will tend to decrease your score.* Keep in mind that these questions are difficult and you are not expected to know the answers to all the questions, especially those in an area that is unfamiliar to you.

## I. Physics

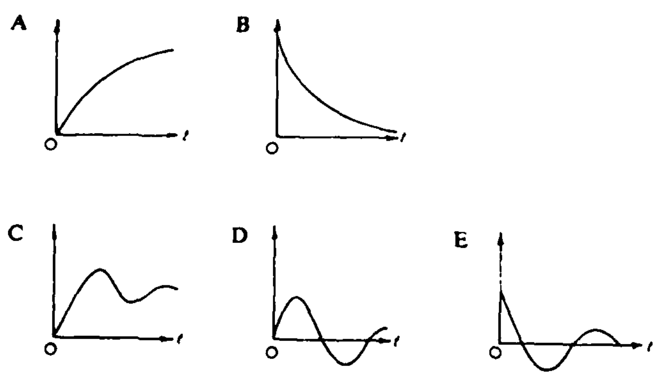
1. The work required to transfer a charge of 6 coulombs against a difference of potential of 110 volts is in joules:

   (A) 18.2
   (B) $6.6 \times 10^2$
   (C) $6.6 \times 10^7$
   (D) $6.6 \times 10^5$
   (E) $6.6 \times 10^9$

2. A battery is connected to a resistor, causing a current of 0.6 amps to flow. When an additional 4.0 ohm resistor is added in series to the circuit, the current drops to 0.5 amps. The emf of the battery is

   (A) 5 volts
   (B) 6 volts
   (C) 12 volts
   (D) 4 volts
   (E) 24 volts

The graphs below represent variables of an electrical circuit as functions of time after the circuit switch is closed. In each case, the circuit specified contains circuit elements connected in series with each other and with a battery. Any capacitor is uncharged at the beginning. Select the graph which most nearly shows the nature of the time dependence of the indicated variable.



3. Which graph represents the charge on the capacitor as a function of time in an underdamped inductance-resistance-capacitance circuit?

(A) A
(B) B
(C) C
(D) D
(E) E

4. A strong X-ray beam striking a very thin gold foil may cause

(A) electrons to leave the foil
(B) an increase in the atomic number of the atoms struck
(C) isotopes of gold to form
(D) the formation of unstable nuclei
(E) a decrease in the atomic number of the atoms struck

5. The mathematical expression describing the flow of current in a series R-L-C circuit with no external source of emf is

(A) $d^2i/dt^2 + (L/R)(di/dt) + i/C = 0$

(B) $d^2i/dt^2 + (R/C)(di/dt) + i/L = 0$

(C) $d^2i/dt^2 + i/LC = 0$

(D) $d^2i/dt^2 + (1/CL)(di/dt) + i/R = 0$

(E) $d^2i/dt^2 + (R/L)(di/dt) + (1/LC)i = 0$

6. The effective value of a sinusoidal alternating emf is equal to its maximum value multiplied by

(A) 1.41
(B) 1.732
(C) 0.623
(D) 0.50
(E) 0.707

7. A parallel-plate capacitor is charged and then disconnected from the charging battery. If the plates of the capacitor are then moved farther apart by the use of insulated handles, which one of the following results?

(A) The charge on the capacitor increases.
(B) The charge on the capacitor decreases.
(C) The capacitance of the capacitor increases.
(D) The voltage across the capacitor remains the same.
(E) The voltage across the capacitor increases.

8. Materials that are good electrical conductors also tend to be good thermal conductors because

(A) they have highly elastic lattice structures
(B) they have energy gaps between the allowed electron energy bonds
(C) impurities aid both processes
(D) surface states are important in both processes
(E) conduction electrons contribute to both processes

9. The term, effective current, as used in sinusoidal a-c circuits means the same as the term,

(A) average current
(B) root-mean-square current
(C) peak current
(D) instantaneous
(E) square root current

10. When a hot bar of iron glows red, the mechanism by which its atoms become excited to radiate this visible light is most likely

(A) the absorption of quanta
(B) electron bombardment
(C) neutron bombardment
(D) mechanical interactions with other atoms (e.g. collisions)
(E) the flow of an electric current

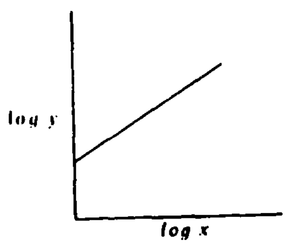
11. When a resistor and a capacitor are connected in series to a dry cell, at the instant of closing the circuit, the

(A) voltage across the resistor is zero
(B) voltage across the capacitor is at maximum
(C) charge on the capacitor is at maximum
(D) current in the circuit is at maximum
(E) power loss is at minimum

12. A current of 5 amp exists in a 10-ohm resistance for 4 minutes. How many coulombs pass through any cross section of the resistor in this time?

(A) 1.2 coul
(B) 12 coul
(C) 120 coul
(D) 1200 coul
(E) 12,000 coul

13. Which of the following equations is best represented by the graph?




(A) $x + y = a^b$

(B) $x - y = e^2$

(C) $ax^2 + by^2 = 0$

(D) $x + y = ab$

(E) $y = ax^b$

14. A coil, a resistor, and a capacitor are connected in series to an a-c generator. If the frequency of the generator is increased, which one of the following will result?

(A) The inductive reactance will increase.
(B) The impedance will increase.
(C) The current will increase.
(D) The current will decrease.
(E) The impedance will be constant.

15. A charge, Q, is placed upon a capacitor, C, at a potential difference, V. The potential energy stored in the capacitor may be determined from which one of the following expressions?

(A) $PE = 1/2\ Q\ V^2$

(B) $PE = 1/2\ C\ V$

(C) $PE = 1/2\ V\ C^2$

(D) $PE = 1/2\ Q^2/C$

(E) $PE = 1/2\ Q^2\ V$

16. The energy of the electrons emitted from a light-sensitive surface will increase when the incident light

(A) increases in intensity
(B) increases in amplitude
(C) decreases in wave length
(D) decreases in frequency
(E) does none of these

17. In order for a 30-volt, 90 watt lamp to work properly when inserted in a 120-volt d-c line, it should have in series with it a resistor whose resistance, in ohms, is

(A) 10
(B) 20
(C) 30
(D) 40
(E) 50

18. The decay of a radioactive sample obeys the following relations:

$$N = N_0 e^{-\lambda t}$$

where N is the amount of sample of time t, and $N_0$ is the amount of sample at time t = 0. The half-life of one of the atoms of the radioactive sample is

(A) $1/\lambda$
(B) $\lambda$
(C) $(\ln 2)/\lambda$
(D) $\lambda \ln 2$
(E) $e^{-\lambda/2}$

19. The magnetic field accompanying a beam of light may be accurately described as being

(A) parallel to the direction of its motion
(B) parallel to the electric field but out of phase by 90°
(C) perpendicular to both the electric field and the direction of travel
(D) parallel to the electric field and the direction of motion
(E) perpendicular to the electric field but parallel to the direction of travel.

20. When minute traces of arsenic (z = 33) are added to pure germanium (z = 32),

(A) n type germanium is formed
(B) p type germanium is formed
(C) the energy gap of germanium is widened
(D) "holes" appear in the germanium
(E) the germanium becomes neutral

## II. Music

21. The *equivalent of the hemidemisemiquaver is*

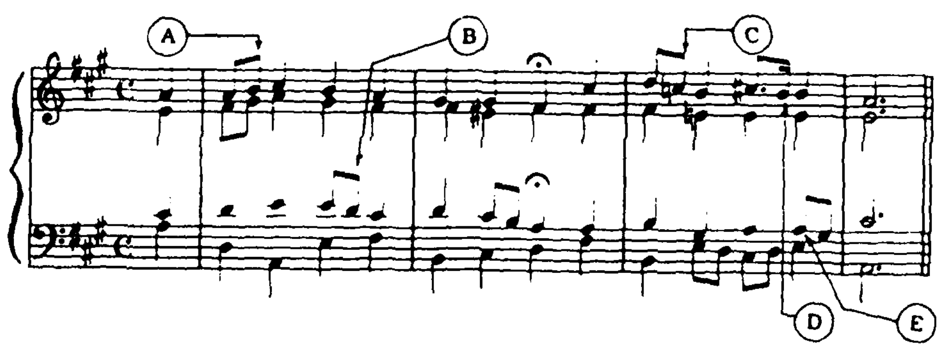
(A) quarter note
(B) sixty-fourth note
(C) half note
(D) sixteenth note
(E) whole note

22. The term stretto is associated with the

(A) fugue
(B) sonata form
(C) suite
(D) canon
(E) motet

23. With reference to the musical illustration below identify a Chromatic Passing Tone.

(A) A
(B) B
(C) C
(D) D
(E) E



24. Upon inversion an Octave becomes a

(A) Prime
(B) Fourth
(C) Seventh
(D) Second
(E) Sixth

25. Philippe de Vitry (1291-1361), the author of a treatise dealing with the logical and consequential application of a reformed system of music and musical notation, called his treatise

(A) Ars Antiqua
(B) Ars Poetica
(C) Ars Sacra
(D) Ars Nova
(E) Ars Profana

26. The scale used in the passage below is

(A) A♭ major
(B) D♭ major
(C) G minor
(D) B♭ major
(E) B♭ minor

27. Descending trill (17th and 18th Centuries, including J.S. Bach) is represented by the melodic ornament

(A) 

(B) 

(C) 

(D) 

(E) 

28. The term "Ligature" is associated basically with

(A) Chamber music
(B) Sonata da Chiesa
(C) Notation
(D) Valves
(E) Conducting technique

29. In Music Theory the term mutation refers to

(A) Figured Bass
(B) Double-diminished Interval
(C) Hexachord
(D) Augmented Ninth
(E) Mordent

30. All of these classifications - homophony, polyphony, monophony - pertain to the aspect of music regarded as

(A) rhythm
(B) texture
(C) harmony
(D) structure
(E) melody

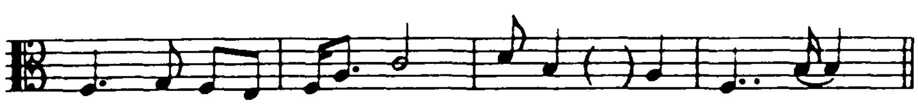
31. An appoggiatura is

(A) a non-harmonic tone sounded on a strong beat and resolved stepwise
(B) an accidental
(C) an enharmonic note
(D) a portamento
(E) a ligature

32. Music of Ancient Greece was notated by means of

(A) neumes
(B) letters
(C) tablature
(D) ligature
(E) movable type

33. Refer to the illustration below in determining the time signature, the key signature, and the correct value of the rest in the third measure.



| | Time | Key | Value of Rest |
|---|---|---|---|
| (A) | $\frac{3}{4}$ | F minor | Eighth |
| (B) | $\frac{4}{4}$ | C major | Sixteenth |
| (C) | $\frac{6}{8}$ | B minor | Quarter |
| (D) | $\frac{5}{4}$ | D major | Eighth |
| (E) | $\frac{4}{2}$ | E major | Quarter |

34. The tonal relationship (illustrated at the keyboard) in the combination of black and white keys separated by one intervening key (six tones) is

(A) diatonic
(B) chromatic
(C) whole-tone
(D) pentatonic
(E) free form

35. To which interval (descending from the initial tone) listed below does The Star-Spangled Banner correspond?

(A) Perfect Prime
(B) Major Second
(C) Perfect Fourth
(D) Minor Second
(E) Minor Third

36. Tierce de Picardie is a

(A) folk song of southern France

(B) French dance in 3/8 meter
(C) major chord followed by a minor chord
(D) final major chord in a composition written mainly in the minor
(E) French Sixth

37. The passage below is best described by which of the following statements?

(A) It is completely diatonic in C major.
(B) It contains a modulation to A minor.
(C) It contains a modulation to G just before the cadence.
(D) It enriches C major through secondary dominants.
(E) It contains modulations to both A and G.

38. A minor tetrachord plus a major tetrachord forms *a(n)*

(A) natural minor scale
(B) pentatonic scale
(C) melodic scale
(D) natural major scale
(E) harmonic scale

39. By "Circle of Fifths" is meant a

(A) method of modulation by dominants
(B) canon going through major keys
(C) a group of Russian composers
(D) chromatic modification of the Greek tetrachord
(E) method of piano-tuning

40. Concerning Twelve-tone compositional technique, the statement which is <u>not</u> correct is:

(A) The octave position of any tone can be changed at will.
(B) The series, or tone row, can be used in its inversion.
(C) The series is available in 50 modifications.
(D) The series can be used in its retrograde inversion.
(E) The series can be used in its retrograde form.

APPENDIX B

TEXT OF PASSAGES

## 'Roos Abundant, Imports O.K. Says U.S.

Despite the objections of some conservation organizations here and in Australia, the government has proposed lifting a five year ban on the import of kangaroo products.

Kangaroos were listed as a 'threatened' species under the Endangered Species Act in 1975. Australia was told that the ban would be reconsidered after Australia had demonstrated that its kangaroos were thriving and that it had developed sound plans for the management of its national symbol. The Office of Endangered Species of the Interior Department now professes itself satisfied with the situation. However, this decision has upset some wildlife groups for a number of reasons. They say no accurate count of kangaroos has been made, that no one really knows what would constitute a sustained yield, and that management plans have not curtailed illegal shooting. Additionally, they fear that some kangaroo populations may be decimated by people eager to profit from the reopening of the U.S. market.

Australia, which is about the size of the United States, is now home to about 32 million kangaroos. Until 1973, these animals were the basis of an industry estimated to be worth five million dollars a year, most of it in hides. In the late 1960's, exports amounted to some 850,000 hides a year, more than half of which went to the United States. The hides, which are tough, flexible, and durable, are used for such items as shoes, saddles, briefcases, and

baseball gloves. In the past five years a modest trade in hides and in kangaroo meat for pet food has been going on with Europe and Japan. The demand has been decreasing, and currently Australian tanners are said to have at least a half-million hides in storage. Australia has for some time been pressuring this country to lift its import ban. According to conservationists, the pressure is coming from the kangaroo industry, but according to an official at the Australian embassy, it is farmers and graziers who have made the biggest fuss. In some areas, kangaroos compete with cattle and sheep for grazing land and trample crops in their nocturnal boundings.

## Warmed-Over Chips

The silicon chip of a microelectronic device must be selectively 'doped' with a relatively small number of atoms of other elements if its various areas are to have the appropriate electrical properties. One of the best ways to accomplish the doping is by ion implantation. This procedure drives the dopant atoms into the silicon with an ion accelerator. A drawback of ion implantation is that the energetic ions frequently disrupt the orderly three-dimensional lattice of the silicon crystal and spoil its electrical properties. Therefore after ion implantation the silicon is usually annealed, or reheated, to restore the lattice. The annealing itself, however, tends to move the dopant atoms out of an optimal configuration. It now appears that if the silicon is annealed not in a furnace but by having only its surface heated with

a laser or electron beam, this considerable drawback is overcome. Not only is the three-dimensional lattice restored but also the dopant atoms take up an even more optimal configuration than before.

Annealing with a pulsed laser beam was introduced in 1974 by two Russian groups. One was at the Kazan Physical-Technical Institute and the other was at the Institute of Semiconductor Physics in Novosibirsk. More recently a group at Stanford University including James F. Gibbons, Fabian Pease and Thomas Sigmon has worked with both laser light and electrons. These have been supplied, not in pulses, but by a continuous finely focused beam that scans the surface of the silicon wafer out of which chips are cut. The energy of the scanning beam can be made high enough to excite strong vibrations among the atoms in the disrupted surface without actually melting it. The crystal lattice reconstitutes itself in the pattern of the undisrupted lattice under it. The vibrations also tend to shake the dopant atoms out of what are called interstitial sites to sites where they substitute for atoms of silicon. Here they can play their part in the electrical behavior of the semiconductor.

The laser or electron annealing enhances the advantages of ion implantation over an older method. In this method the wafer is heated in the presence of a vapor of a dopant so that the atoms of the dopant can diffuse into it. In the course of ion implantation the wafer can be metered for charge in order to monitor the total

amount of the doping which cannot be done in a furnace. Moreover, ion implantation can be confined to particular parts of the surface by masking, and the effects of the masking are precise. In the diffusion method atoms that have diffused into a wafer can also diffuse sideways under a mask.

The Stanford group has also found other uses for this annealing process. For example, heating a surface consisting not of a disrupted crystal lattice but of numerous small crystals transforms the small crystals into larger ones. Semiconductor devices fabricated on these polycrystalline surfaces have properties similar to those of devices made on single-crystal material. Furthermore, 'islands' of single-crystal material in the polycrystalline surface have dimensions suitable for the fabrication of high-density microelectronic devices. The implantation of dopants with suitable masking would make an island a transistor. Repeating the processs with layers of silicon laid down on top of the first layer might make it possible to fabricate a microelectronic device in three dimensions instead of the usual two.

## The Many Methods of Music Notation:

## Shapes and Staves

The earliest graphic representations used in music notation were squiggles, called neumes, that were drawn upward and downward as the song rose and fell in pitch. How much the squiggles rose or fell

depended on who drew them, and so someone unfamiliar with the song would be unable to determine the exact pitches represented. The system was designed to serve only as a reminder of the song after the song had already been learned.

With the advent of more efficient quill pens, transcribers drew more precisely defined squiggles, and pitches were distinguished by their shapes. Shapes continued to be added, however, to the extent that only advanced musicologists could learn them all. In order to solve the main problems of providing both precision and readability, a single reference line was added to be used in discerning the amount of rise and fall in pitch. That line indicated the fixed pitch of F, and the improvement was so obvious that a second and third line, representing A and C, were soon added. Shapes were placed on the lines and in spaces, just as notes are placed on and between the staff lines in our present system. Emphasis should be placed on certain properties of the system that made it so effective. It was simple, with few lines and each position on the staff represented only one pitch, enabling a more accurate discernment of intervals.

The new staff, which was so effective for vocal scores since it required only that each position on the staff represent one pitch, was soon applied to instrumental scores. However with the greater need for different keys in instrumental music, lines could no longer represent specific pitches. Rather, pitches were defined by

shapes which were called clefs added to the beginning of the staves, and intervals represented by the lines of the staff were likewise no longer fixed. With the introduction later of fifteen key signatures, a music student was required to learn fifteen different languages. Additionally, the range of many instruments could not be easily accomodated on three-line staves. Therefore, more lines were added, until it became common to see staves with eleven and fifteen lines. Thus, an expansion in the readability of this system was at the expense of readability.

To help in reading such large staves, some notation innovators have experimented with the use of lines of varying weights. In 1857, William Striby proposed a system of six-line staves two octaves apart so that staves for the right and left hands would read alike. Recognizing that a six-line staff bordered on being unreadable, Striby made the fourth line from the bottom heavier than the others. More recent inventors, designing staves of more than five lines, also have used weighted lines to assist in rapid indexing.

Another approach to the indexing of staves is the irregular spacing or omission of staff lines, such as, the non-uniformly spaced lines found in Mitcherd's approach to accidental-free notation. Mitcherd constructed a staff of five lines per octave, with the lines corresponding to the black keys of the piano and with half-tone, line-to-space intervals. Other inventors, also favoring half-tone,

line-to-space intervals, have arrived at twelve-level staves for the chromatic scale indexed by omission. In another system, the same technique has been applied to the diatonic scale.

The present use of clefs on two five-line staves, the so-called 'great staff,' resulted from removing the center line from an eleven-line staff. On the larger staff with the center line left in, one had to read by intervals, since there was no line omitted to help in determining the location of notes. On the present staff, one can determine the exact location of notes but at a terrible price. The musician has one language for the left hand and another for the right since the corresponding staff lines of the two clefs do not represent the same notes.

## Parakeets: Ideal Pets

Parakeets are ideal pets for people who have limited space, time and money. The lack of a yard or big house is of no problem with parakeets as there would be with other common pets. A parakeet's cage takes up very little room, and when he is let out to fly even a small apartment provides him with sufficient space for exercise. Parakeets fit well into the schedule of students or working people who have to be away from home for long periods of the day. These amusing, little birds take care of themselves very well as long as water and food are provided for them every day.

Once the initial expense of buying the bird and cage is made, the other expenses involved in keeping the bird are minimal. Parakeets range in price from about five to ten dollars depending on their color. The least expensive color is the green-bodied bird with a yellow face. The wide variety of colors of parakeets that are available on the market today resulted from careful breeding of the color mutant offspring of light green-bodied and yellow-faced parakeets. The light green body and yellow face color combination is the color of parakeets in their natural habitat, Australia. The first living parakeets were brought to Europe from Austral'a by John Gould, a naturalist, in 1840. The first color mutations which appeared in 1872 in Belgium were completely yellow. The most popular color of parakeets in the United States is sky-blue. These birds which appeared in 1878 in Europe have sky-blue bodies and white faces. There are over 66 different colors listed by the Color and Technical Committee of the Budgerigar Society. In addition to the original light green-bodied and yellow-faced birds, colors of parakeets include varying shades of violets, blues, grays, greens, yellows, whites and multi-colored variations. The choice of color is up to the buyer's preference and budget, since all colors make equally fine pets.

The price of new cages has soared in cost lately, but often excellent cages which are quite satisfactory if thoroughly washed can be found for a few dollars at garage sales. Also, cages can be

easily made with half inch mesh wire at a reasonable cost. They can be built to fit a parakeet owner's vacant living space. Homemade cages are particularly desirable if more than one parakeet is purchased due to the high cost of large cages in pet stores.

Feeding a parakeet is relatively inexpensive, since parakeets can get their necessary minerals, proteins, carbohydrates, fats and vitamins primarily from commercially packaged bird seed and food stuffs available in most homes. Calcium can be provided for a bird by occasional bread and milk feedings, oyster shell grit, crushed egg shell and cuttle fish bone. Proteins are contained in canary seed, millet seed and grape seed, but in limited quantities so that occasional feedings of good quality crushed dry dog food is a good supplement. Carbohydrates and fats are plentiful in seed, and no supplement is necessary. Vitamin A is necessary for parakeets, for without it they develop severe symptoms such as inflammation of the conjunctiva of the eye and sterility. Vitamin A is easily supplied a bird by feedings of dark green leaves, whole milk, grated carrot and egg yolk. A parakeet's owner will look forward to feeding his pet dandelion leaves, romaine lettuce or carrot greens. The birds enjoy rolling on the wet leaves and chomping on the tasty leaves and soon learn to eagerly anticipate this daily green feeding. His behavior with greens is amusing and certainly an inexpensive, beneficial treat for one's pet.

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# APPENDIX C

## INTER-RATER RELIABILITY COEFFICIENTS FOR SENTENCE RATINGS IN CONTENT STRUCTURE

| | Text | | |
|---|---|---|---|
| | Laser | Notation | Parakeets |
| Rater 1: Rater 2 | .91 | .94 | .92 |
| Rater 1: Rater 3 | .88 | .95 | .91 |
| Rater 2: Rater 3 | .85 | .89 | .88 |

# APPENDIX D

# CONTENT STRUCTURE RATINGS FOR SENTENCES IN EXPERIMENTAL TEXTS

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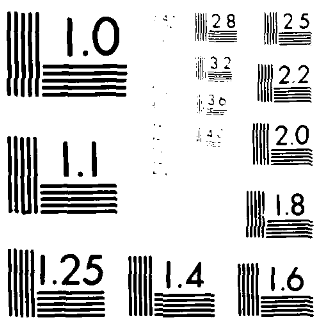


MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

Key: H = High
I = Intermediate
L = Low

Warmed - Over Chips

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H 18. The price of new cages has soared in cost lately, but often excellent cages which are quite satisfactory if thoroughly washed can be found for a few dollars at garage sales.

H 19. Also, cages can be easily made with half inch mesh wire at a reasonable cost.

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I 23. Calcium can be provided for a bird by occasional bread and milk feedings, oyster shell grit, crushed egg shell and cuttle fish bone.

I 24. Proteins are contained in canary seed, millet seed and grape seed, but in limited quantities so that occasional feedings of good quality crushed dry dog food is a good supplement.

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# APPENDIX E

# RECOGNITION MEMORY TESTS

Key: Y = Yes, the same as the original
N = No, changed from the original
H = High content structure rating
I - Intermediate content structure rating
L = Low content structure rating
#'s = Original sentence number

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Y 1. Despite the objections of some conservation organizations and in Australia, the government has proposed lifting a five year ban on the import of kangaroo products. (1)

N 2. The hides, which are tough, flexible, and durable, are used for such items as boots, suitcases, and footballs. (11)

N 3. In some areas, kangaroos compete with ranchers for grazing land and trample crops in their nocturnal boundings. (16)

Y 4. The demand has been decreasing, and currently Australian tanners are said to have at least a half-million hides in storage. (13)

N 5. Australia was told that the ban would be reconsidered after Australia had demonstrated that its kangaroos were thriving and that it had developed wildlife preserves for its national symbol. (3)

Y 6. In the late 1960's, exports amounted to some 850,000 hides a year, more than half of which went to the United States. (10)

Warmed-Over Chips

N 1. The Russian group has also found other uses for this annealing process. (22-H)

N 2. The laser or electron annealing enhances the advantages of the diffusion method. (17-H)

N 3. For example, heating a surface consisting not of a disrupted crystal lattice but of numerous large crystals transforms the large crystals into smaller ones. (23-I)

Y 4. Annealing with a pulsed laser beam was introduced in 1974 by two Russian groups. (9-L)

N 5. The energy of the scanning beam can be made high enough to excite strong vibrations among only the dopant atoms in the disrupted surface without actually melting it. (13-I)

Y 6. The vibrations also tend to shake the dopant atoms out of what are called interstitial sites to sites where they substitute for atoms of silicon. (15-L)

N 7. In the ion implantation method atoms that have diffused into a wafer can also diffuse sideways under a mask. (21-L)

Y 8. Not only is the three-dimensional lattice restored but also the dopant atoms take up an even more optimal configuration than before. (8-H)

Y 9. It now appears that if the silicon is annealed not in a furnace but by having only its surface heated with a laser or electron beam, this considerable drawback is overcome. (7-H)

N 10. One was at the University of Kazan and the other was at the Institute of Semiconductor Devices in Novosibirsk. (10-L)

Y 11. In this method the wafer is heated in the presence of a vapor of a dopant so that the atoms of the dopant can diffuse into it. (18-I)

Y 12. These have been supplied, not in pulses, but by a continuous finely focused beam that scans the surface of the silicon wafer out of which chips are cut. (12-I)

<u>The Many Methods of Music Notation: Shapes and Staves</u>

N 1. Thus, an expansion in the readability of this system was at the expense of accuracy. (17-H)

Y 2. In order to solve the main problems of providing both precision and readability a single reference line was added to be used in discerning the amount of rise and fall in pitch. (6-H)

Y 3. In 1857, William Striby proposed a system of six-line staves two octaves apart so that staves for the right and left hands would read alike. (19-L)

Y 4. On the larger staff with the center line left in one had to read by intervals, since there was no line omitted to help in determining the location of notes. (27-I)

N 5. Shapes continued to be added, however, to the extent that only advanced instrumentalists could learn them all. (5-I)

N 6. Therefore, more lines were added, until it became common to see scores with eleven and fifteen lines. (16-I)

N 7. In another system, the same technique of weighted lines has been applied to the diatonic scale. (25-L)

N 8. Using accidental-free notation, one can determine the exact location of notes but at a terrible price. (28-H)

Y 9. The present use of clefs on two five-line staves, the so-called "great staff," resulted from removing the center line from an eleven-line staff. (26-H)

N 10. That line indicated the fixed pitch of G and the improvement was so obvious that a second and third line, representing A and C, were soon added. (7-L)

Y 11. To help in reading such large staves, some notation innovators have experimented with the use of lines of varying weights. (18-I)

Y 12. The musician has one language for the left hand and another for the right since the corresponding staff lines of the two clefs do not represent the same notes. (29-L)

## <u>Parakeets</u>: <u>Ideal</u> <u>Pets</u>

Y 1. The wide variety of colors of parakeets that are available on the market today resulted from careful breeding of the color mutant offspring of light green-bodied and yellow-faced parakeets. (9-I)

Y 2. Once the initial expense of buying the bird and cage is made, the other expenses involved in keeping the bird are minimal. (6-H)

Y 3. His behavior with greens is amusing and certainly an inexpensive, beneficial treat for one's pet. (30-L)

N 4. In addition to the most common light green-bodied and yellow-faced birds, colors of parakeets include varying shades of violets, blues, grays, greens, yellows, whites and multi-colored variations. (16-I)

N 5. These amusing little birds take care of themselves very well as long as vitamins and minerals are provided for them every day. (5-H)

N 6. Parakeets range in price from about five to ten dollars depending on their size. (7-I)

N 7. The light green body and yellow face color combination is the color of parakeets in the jungle, their natural habitat. (10-L)

N 8. The price of new cages has soared in cost lately, but often excellent cages which are quite satisfactory if thoroughly washed can be found for a few dollars at auctions. (18-H)

N 9. There are over 77 different colors listed by the Color and Technical Committee of the Budgerigar Society. (15-L)

Y 10. A parakeet's owner will look forward to feeding his pet dandelion leaves, romaine lettuce or carrot greens. (28-I)

Y 11. The first living parakeets were brought to Europe from Australia by John Gould, a naturalist, in 1940. (11-L)

Y 12. A wonderful pet is available for those with little extra capital, space and time, for his amusing tricks and never ending curiosity will delight any owner. (31-H)

# APPENDIX F

# CERTIFICATE OF INFORMED CONSENT

PRECEDING PAGE BLANK-NOT FILMED

Project: Reading Research

Investigator: Deborah P. Birkmire
Graduate Student
Department of Educational Studies
University of Delaware

Purpose: The study in which you are about to participate is an investigation of reading. You will be asked to read three texts that are approximately two-typewritten pages in length and to answer several questions about the material you read. These texts will be presented on a PLATO terminal during one session. This session will take approximately one hour to complete. During a second session, which will also last about one hour, you will be asked to take two "paper and pencil" standardized tests. Upon completion of both sessions you will be paid ten dollars ($10.00) plus any additional money you may earn as a result of your performance. You will be assigned a code number during the first session which will be used to identify all your responses. Only the principal investigator will have access to the key associating your name and code number. This key will be destroyed on or before September 1, 1981.

Consent: My signature below certifies that the project in which I am about to participate has been explained to me and that all of my questions have been answered satisfactorily. I voluntarily agree to participate and I understand that I may agree to participate or

decline to participate without any penalty whatsoever (e.g., course grade). Furthermore, I recognize that I may withdraw my participation at any point, or refuse to answer any question without penalty (e.g., course grade).

Signature:______________________________ Date:__________

Date of Birth: ______________________________

Major: ______________________________

Class (i.e., Junior, Senior): ______________

APPENDIX G

DIRECTIONS TO SUBJECTS

## Introductory Directions

Directions for reading passages

In this experiment you will be asked to read three expository passages which will be presented on this PLATO terminal. Each passage is approximately two type-written pages in length. A short set of directions will precede presentation of each passage. After you have read these directions, press the key labeled NEXT on the keyset.

—Be sure to press the key firmly and only once--

press NEXT when you are ready to continue

The title of the passage will then appear on the screen. After reading this, press NEXT. The first sentence of the passage will then be presented on the screen. After you read the sentence, again press NEXT. The second sentence of the passage will now appear and first sentence will be erased. Repeat this procedure until you have read the entire first page.

press NEXT to continue

When you press NEXT after reading the last sentence of the first page, the first sentence of the second page will disappear. The same procedure that was used with the first page will be used with this and each succeeding page until the passage is completed.

press NEXT to continue

After reading each passage completely through once, you will be given the opportunity to read it a second time following the same procedures.

When you feel you understand these directions press DATA

Objective Test

After you have read a passage twice, you will be given a short test about the material in the passage. More explicit directions will be given before you take the test. You will be given points for each question you answer correctly, but the number you receive for each correct answer will depend upon how fast you read the passage. The less total time you take to read a passage both times, the more points you will receive for each correct answer. These points will be presented in a payoff matrix.

press NEXT to continue

BACK to review

Payoff Matrix

| Total Reading Time | Number Points for Each Correct Answer |
|---|---|
| time $<$ 4 min | 5 |
| 4 min $\leq$ time $<$ 5 min | 3 |
| 5 min $\leq$ time $<$ 6 min | 3 |
| 6 min $\leq$ time $<$ 7 min | 2 |
| 7 min $\leq$ time $<$ 8 min | 1 |
| time $\geq$ 8 min | 0 |

Note: $\leq$ means less than or equal, $<$ means less than

At the end of the experiment your total number of points will be accumulated and you will be given two cents for each point you have received. The total possible number of points that can be accumulated is 180 which will be exchanged for $3.60.

press NEXT to continue

BACK to review

Reading Strategy

The best strategy to use in reading these passages is to read as fast as you can, and still comprehend what you are reading. If you read too fast, you will not do well on the test. If you read

too slow or try to memorize everything in the passage, you will not receive many points for correct answers. To get the largest number of points you should read and learn what you think is important as quickly as possible.

press NEXT to continue

BACK to review

Review of Instructions

1 - Directions for reading passages

2 - Recognition/memory tests

3 - Payoff matrix

4 - Reading strategy

press a number from 1 to 4 to review any section

press NEXT to start the practice

Practice

You will be given a chance to practice this procedure before you read the main passages.

press DATA to continue

BACK to review

General Passage Directions

Practice Passage

Instructions

The passage you are about to read is entitled "'Roos Abundant, Imports O.K. Says U.S."

The number of points that you may receive is based on the rate at which you read the passage through twice as described previously. However, since this is a practice run, the points you accumulate here will not count towards your final total. This is simply to give you an idea of how fast you are reading and to allow you practice so that you are comfortable with these procedures.

press NEXT for the time-point matrix for this passage

Payoff Matrix

| Total Reading Time | Number points per Correct Answer |
|---|---|
| time $<$ 2.5 min | 5 |
| 2.5 min $\leq$ time $<$ 3.0 min | 4 |
| 3.0 min $\leq$ time $<$ 3.5 min | 3 |
| 3.5 min $\leq$ time $<$ 4.0 min | 2 |
| 4.0 min $\leq$ time $<$ 4.5 min | 1 |
| time $\geq$ 4.5 min | 0 |

Note: $\leq$ means less than or equal, $<$ means less than

press NEXT to continue

*Remember: After reading the title or a sentence, press NEXT. This will present the next sentence and erase the current one.

Note: The time spent reading a passage is calculated from when you see the title until you read the last sentence.

press NEXT to begin this passage

*This final frame of directions was presented after presentation of the purpose setting instructions.

First Experimental Passage

Instructions

The passage you are about to read is entitled "Warmed Over Chips" and is about twice as long as the passage you just read.

The number of points that you may receive is based on the rate at which you read the passage through twice as described previously.

press NEXT for the time-point matrix for this passage

Payoff Matrix

| Total Reading Time | Number Points per correct Answer |
|---|---|
| time $<$ 5.0 min | 5 |
| 5.0 min $\leq$ time $<$ 5.5 min | 4 |
| 5.5 min $\leq$ time $<$ 6.0 min | 3 |
| 5.0 min $\leq$ time $<$ 6.5 min | 2 |
| 5.5 min $\leq$ time $<$ 7.0 min | 1 |
| time $\geq$ 7.0 min | 0 |

Note: $\leq$ means less than or equal, $<$ means less than

press NEXT to continue

<u>Second Experimental Passage</u>

Instructions

The passage you are about to read is entitled "The Many Methods of Musical Notation: "Shapes and Staves" and is about the same length as the passage you just read.

The number of points that you may receive is based on the rate at which you read the passage through <u>twice</u> as described

previously.

press NEXT for the time-point matrix for this passage

Payoff Matrix

| Total Reading Time | Number Points per correct Answer |
|---|---|
| time $<$ 5.5 min | 5 |
| 5.5 min $\leq$ time $<$ 6.0 min | 4 |
| 6.0 min $\leq$ time $<$ 6.5 min | 3 |
| 6.5 min $\leq$ time $<$ 7.0 min | 2 |
| 7.0 min $\leq$ time $<$ 7.5 min | 1 |
| time $\geq$ 7.5 min | 0 |

Note: $\leq$ means less than or equal, $<$ means less than

press NEXT to continue

Third Experimental Passage

Instructions

The passage you are about to read is entitled "Parakeets: Ideal Pets" and is about the same length as the passage you just read.

The number of points that you may receive is based on the rate at which you read the passage through twice as described previously.

press NEXT for the time-point matrix for this passage

Payoff Matrix

| Total Reading Time | Number Points per correct Answer |
|---|---|
| time $<$ 4.5 min | 5 |
| 4.5 min $\leq$ time $<$ 5.0 min | 4 |
| 5.0 min $\leq$ time $<$ 5.5 min | 3 |
| 5.5 min $\leq$ time $<$ 6.0 min | 2 |
| 6.0 min $\leq$ time $<$ 6.5 min | 1 |
| time $\geq$ 6.5 min | 0 |

Note: $\leq$ means less than or equal, $<$ means less than

press NEXT to continue

Note: The title and corresponding payoff matrix in each of these sets of instructions will change dependent upon the presentation order.

## Purpose Setting Instructions

'Roos Abundant, Imports O.K. Says U.S.

General. The practice passage is about the lifting of an import ban on kangaroo products. You will be asked several questions later about various aspects of that topic.

press NEXT to continue

Specific High and Specific Low. After reading the practice passage you will . asked several objective questions about:

(a) the uses of kangaroo products

(b) the number of hides exported before the ban

(c) the animals kangaroos compete with

Please memorize these three topics now. When you are satisfied that you know them press NEXT.

Warmed Over Chips

General. This next passage is about the benefits and advantages of laser annealing. You will be asked several questions later about various aspects of that topic.

press NEXT to begin this passage

Specific High. After reading the next passage you will be

asked several objective questions about it. Some of the questions will be on:

(a) dopant atoms after laser annealing

(b) what enhances ion implantation

(c) who discovered other uses for laser annealing

Please memorize these three topics now. When you are satisfied that you have learned them press NEXT.

Specific Low. After reading the next passage you will be asked several objective questions about it. Some of the questions will be on:

(a) who first used a pulsed laser

(b) what substitutes for silicon atoms

(c) when masking is not successful

Please memorize these three topics now. When you are satisfied that you have learned them press NEXT.

The Many Methods of Musical Notation; Shapes and Staves

General. This next passage is about the evolution of musical notation. You will be asked several questions later about various aspects of that topic.

press NEXT to begin the passage

Specific High. After reading the next passage you will be asked several questions about it. Some of the questions will be on:

(a) how the original single reference line was used

(b) the price of increased precision

(c) the major advantage of the present staff

Please memorize these three topics now. When you are satisfied that you have learned them press NEXT.

Specific Low. After reading the next passage you will be asked several questions about it. Some of the questions will be on:

(a) the pitch indicated by the first reference line

(b) the system proposed by Striby

(c) The major disadvantage of the present staff

Please memorize these three topics now. When you are satisifed that you have learned them press NEXT.

Parakeets: Ideal Pets

General. This next passage is about the advantages of parakeets as pets. You will be asked several questions later about various aspects of that topic.

press NEXT to begin this passage

Specific High. After reading the next passage you will be asked several objective questions about it. Some of the questions will be on:

(a) the initial expenses

(b) where used cages can be found

(c) the behavior that makes parakeets delightful

Please memorize these three topics now. When you are satisified that you have learned them press NEXT.

Specific Low. After reading the next passage you will be asked several questions about it. Some of the questions will be on:

(a) the natural habitat of parakeets

(b) the number of colors of parakeets

(c) what provides an inexpensive treat

Please memorize these three topics now. When you are satisfied that you have learned them press NEXT.

Topic Recall Instructions for Specific High and Specific Low Conditions.

Please recall the 3 topics you just memorized. Use the index card provided. Please use words and phrases that are identical

or very close to those used originally. However, the order of the topics is not important. When you are done have the experimenter check your answers.

press NEXT to continue

BACK to review topics

Directions for Recognition Memory Tests

You will now be shown a set of statements. Your task is to determine whether those statements appeared in the passage you just read. If the statement was in the passage press 'Y' (for yes). If the sentence did not appear in the passage, press "N" (for No).

press NEXT to start the test

APPENDIX H

MEAN NUMBER OF TRIALS NEEDED TO RECALL TOPICS TO CRITERION BY INSTRUCTIONAL CONDITION BY TEXT

| | Text | | | | | |
|---|---|---|---|---|---|---|
| | Laser | | Notation | | Parakeet | |
| | $\overline{X}$ | SD | $\overline{X}$ | SD | $\overline{X}$ | SD |
| Specific High | 2.63 | 0.93 | 2.50 | 0.94 | 2.10 | 0.31 |
| Specific Low | 2.27 | 0.58 | 2.23 | 0.63 | 2.27 | 0.52 |

# APPENDIX I

## STATISTICS FOR TESTING OUTLYING OBSERVATIONS

A. For testing the significance of the largest observation in a sample of size n from a normal population:

$$\frac{S_n^2}{S^2} = \frac{\sum_{i=1}^{n-1} (x_i - \bar{x}_n)^2}{\sum_{i=1}^{n} (x_i - \bar{x})^2}$$

where $x_1 \leq x_2 \leq \ldots \leq x_n$, $\bar{x}_n = \frac{1}{n-1} \sum_{i=1}^{n-1} x_i$ and $\bar{x} = \frac{1}{n} \sum_{i=1}^{n} x_i$

B. A similar statistic $\frac{S_1^2}{S^2}$ was used when the most extreme observation was the smallest.

C. The second most extreme point in a sample was tested using the appropriate statistic from above, excluding the most extreme observation from the calculation of the sample mean $(\bar{x})$.

# APPENDIX J

## STATISTICAL ANALYSES TABLES

TABLE 1J

Nonorthogonal *MANOVA* of Transformed (LN X) Reading Rates (WPM) for All Sentences

| Source of Variation | df | Multivariate F | Multivariate p | Univariate F | Univariate p |
|---|---|---|---|---|---|
| I. *Grand Mean* | | | | | |
| A. Text | 1 | 91.22 | .0001* | | |
| Laser-Notation | | | | 8.96 | .0037* |
| Laser-Parakeet | | | | 169.58 | .0001* |
| B. Reading | | | | | |
| 1st-2nd | | | | 320.13 | .0001* |
| C. Content Structure | | 150.67 | .0001* | | |
| High-Intermediate (High-Int) | | | | 252.98 | .0001* |
| Intermediate-Low (Int-Low) | | | | 13.64 | .0004* |
| D. Text X Reading | | 9.34 | .0003* | | |
| Laser-Notation X 1st-2nd | | | | 3.32 | .0720 |
| Laser-Parakeet X 1st-2nd | | | | 18.89 | .0001* |

*α = .01

TABLE 1J (Continued)

Nonorthogonal MANOVA of Transformed (LN X) Reading Rates (WPM) for All Sentences

| Source of Variation | df | Multivariate F | Multivariate p | Univariate F | Univariate p |
|---|---|---|---|---|---|
| E. Text X Content Structure | | 51.20 | .0001* | | |
| Laser-Notation X High-Int | | | | 10.19 | .0020* |
| Laser-Notation X Int-Low | | | | 2.12 | .1495 |
| Laser-Parakeet X High-Int | | | | 199.60 | .0001* |
| Laser-Parakeet X Int-Low | | | | 7.74 | .0067* |
| F. Reading X Content Structure | | 3.99 | .0222 | | |
| 1st-2nd X High-Int | | | | 3.87 | .0525 |
| 1st-2nd X Int-Low | | | | 7.28 | .0085 |
| G. Text X Reading X Content Structure | | 4.13 | .0043* | | |
| Laser-Notation X 1st-2nd X High-Int | | | | 1.54 | .2174 |
| Laser-Notation X 1st-2nd X Int-Low | | | | 0.92 | .3410 |
| Laser-Parakeet X 1st-2nd X High-Int | | | | 3.37 | .0700 |
| Laser-Parakeet X 1st-2nd X Int-Low | | | | 3.22 | .0762 |

TABLE 1J (Continued)

Nonorthogonal MANOVA of Transformed (LN X) Reading Rates (WPM) for All Sentences

| Source of Variation | df | Multivariate F | Multivariate p | Univariate F | Univariate p |
|---|---|---|---|---|---|
| II. Group | | | | | |
| A. Sum | 1 | | | | |
| Physics-Music | | | | 0.96 | .3296 |
| B. Group X Text | | 22.47 | .0001* | | |
| Physics-Music X Laser-Notation | | | | 38.88 | .0001* |
| Physics-Music X Laser-Parakeet | | | | 28.02 | .0001* |
| C. Group X Reading | | | | | |
| Physics-Music X 1st-2nd | | | | 0.00 | .9444 |
| D. Group X Content Structure | | 0.25 | .7784 | | |
| Physics-Music X High-Int | | | | 0.41 | .5225 |
| Physics-Music X Int-Low | | | | 0.03 | .8674 |
| E. Group X Text X Reading | | 4.65 | .0122 | | |
| Physics-Music X Laser-Notation X 1st-2nd | | | | 9.15 | .0033 |
| Physics-Music X Laser-Parakeet X 1st-2nd | | | | 0.52 | .4745 |

TABLE 1J (Continued)

Nonorthogonal MANOVA of Transformed (LN X) Reading Rates (WPM) for All Sentences

| Source of Variation | df | Multivariate F | Multivariate p | Univariate F | Univariate p |
|---|---|---|---|---|---|
| F. Group X Text X Content Structure | | 12.63 | .0001* | | |
| Physics-Music X Laser-Notation X High-Int | | | | 35.43 | .0001* |
| Physics-Music X Laser-Notation X Int-Low | | | | 0.95 | .3315 |
| Physics-Music X Laser-Parakeet X High-Int | | | | 17.64 | .0001* |
| Physics-Music X Laser-Parakeet X Int-Low | | | | 0.01 | .9190 |
| G. Group X Reading X Content Sructure | | 0.82 | .4460 | | |
| Physics-Music X 1st-2nd X High-Int | | | | 0.50 | .4824 |
| Physics-Music X 1st-2nd X Int-Low | | | | 1.62 | .2066 |
| H. Group X Text X Reading X Content Structure | | 1.461 | .2233 | | |
| Physics-Music X Laser-Notation X 1st-2nd X High-Int | | | | 0.63 | .4284 |
| Physics-Music X Laser-Notation X 1st-2nd X Int-Low | | | | 1.32 | .2547 |

TABLE 1J (Continued)

Nonorthogonal MANOVA of Transformed (LN X) Reading Rates (WPM) for All Sentences

| Source of Variation | df | Multivariate F | Multivariate p | Univariate F | Univariate p |
|---|---|---|---|---|---|
| Physics-Music X Laser-Parakeet X 1st-2nd X High-Int | | | | 0.67 | .4153 |
| Physics-Music X Laser-Parakeet X 1st-2nd X Int-Low | | | | 0.37 | .5431 |
| III. Instructions | 2 | | | | |
| A. Sum | | | | 1.53 | .2221 |
| General Specific High (Gen-SH) | | | | | |
| Specific High-Specific Low (SH-SL) | | | | | |
| B. Instructions X Text | | 4.09 | .0035* | | |
| (Gen-SH & SH-SL) X Laser-Notation | | | | 2.41 | .0963 |
| (Gen-SH & SH-SL) X Laser-Parakeet | | | | 5.76 | .0046* |
| C. Instructions X Reading | | | | 3.18 | .0467 |
| (Gen-SH & SH-SL) X 1st-2nd | | | | | |

TABLE 1J (Continued)

Nonorthogonal MANOVA of Transformed (LN X) Reading Rates (WPM) for All Sentences

| Source of Variation | df | Multivariate F | Multivariate p | Univariate F | Univariate p |
|---|---|---|---|---|---|
| D. Instructions X Content Structure | | 0.44 | .7803 | | |
| (Gen-SH & SH-SL) X High-Int | | | | 0.25 | .7793 |
| (Gen-SH & SH-SL) X Int-Low | | | | 0.47 | .6290 |
| E. Instructions X Text X Reading | | 2.23 | .0684 | | |
| (Gen-SH & SH-SL) X Laser-Notation X 1st-2nd | | | | 1.34 | .2684 |
| (Gen-SH & SH-SL) X Laser-Parakeet X 1st-2nd | | | | 3.47 | .0357 |
| F. Instructions X Text X Content Structure | | 1.17 | .3179 | | |
| (Gen-SH & SH-SL) X Laser-Notation X High-Int | | | | 2.24 | .1126 |
| (Gen-SH & SH-SL) X Laser-Notation X Int-Low | | | | 2.94 | .0585 |
| (Gen-SH & SH-SL) X Laser-Parakeet X High-Int | | | | 1.70 | .1885 |
| (Gen-SH & SH-SL) X Laser-Parakeet X Int-Low | | | | 2.55 | .0838 |

TABLE 1J (Continued)

Nonorthogonal MANOVA of Transformed (LN X) Reading Rates (WPM) for All Sentences

| | | Multivariate | | Univariate | |
|---|---|---|---|---|---|
| Source of Variation | df | F | p | F | p |
| G. Instructions X Reading X Content Structure | | 1.56 | .1886 | | |
| (Gen-SH & SH-SL) X 1st-2nd X High-Int | | | | 0.44 | .6437 |
| (Gen-SH & SH-SL) X 1st-2nd X Int-Low | | | | 2.52 | .0862 |
| H. Instructions X Text X Reading X Content Structure | | 1.16 | .3271 | | |
| (Gen-SH & SH-SL) X Laser-Notation X 1st-2nd X High-Int | | | | 2.92 | .0593 |
| (Gen-SH & SH-SL) X Laser-Notation X 1st-2nd X Int-Low | | | | 1.90 | .1557 |
| (Gen-SH & SH-SL) X Laser-Parakeet X 1st-2nd X High-Int | | | | 1.76 | .1775 |
| (Gen-SH & SH-SL) X Laser-Parakeet X 1st-2nd X Int-Low | | | | 0.75 | .4770 |
| IV. Group X Instructions | 2 | | | | |
| A. Sum | | | | 1.31 | .2747 |
| Physics-Music X Gen-SH & SH-SL | | | | | |

TABLE 1J (Continued)

Nonorthogonal MANOVA of *Transformed* (LN X) Reading Rates (WPM) for All Sentences

| Source of Variation | df | Multivariate F | Multivariate p | Univariate F | Univariate p |
|---|---|---|---|---|---|
| B. Group X Instructions X Text | | 1.12 | .3466 | | |
| Physics-Music X (Gen-SH & SH-SL) X Laser-Notation | | | | 1.24 | .2940 |
| Physics-Music X (Gen-SH & SH-SL) X Laser-Parakeet | | | | 1.57 | .2149 |
| C. Group X Instructions X Reading | | | | 3.17 | .0471 |
| Physics-Music X (Gen-SH & SH-SL) X 1st-2nd | | | | | |
| D. Group X Instructions X Content Structure | | 1.56 | .1880 | | |
| Physics-Music X (Gen-SH & SH-SL) X High-Int | | | | 0.63 | .5328 |
| Physics-Music X (Gen-SH & SH-SL) X Int-Low | | | | 3.00 | .0550 |
| E. Group X Instructions X Text X Reading | | 2.95 | .0218 | | |
| Physics-Music X (Gen-SH & SH-SL) X Laser-Notation X 1st-2nd | | | | 5.90 | .0041 |
| Physics-Music X (Gen-SH & SH-SL) X Laser-Parakeet X 1st-2nd | | | | 0.41 | .6655 |

TABLE 1J (Continued)

Nonorthogonal MANOVA of Transformed (LN X) Reading Rates (WPM) for All Sentences

| Source of Variation | df | Multivariate F | Multivariate p | Univariate F | Univariate p |
|---|---|---|---|---|---|
| F. Group X Instructions X Text X Content Structure | | 2.39 | .0186 | | |
| Physics-Music X (Gen-SH & SH-SL) X Laser-Notation X High-Int | | | | 1.87 | .1611 |
| Physics-Music X (Gen-SH & SH-SL) X Laser-Notation X Int-Low | | | | 1.09 | .3420 |
| Physics-Music X (Gen-SH & SH-SL) X Laser-Parakeet X High-Int | | | | 5.47 | .0059 |
| Physics-Music X (Gen-SH & SH-SL) X Laser-Parakeet X Int-Low | | | | 5.05 | .0085 |
| G. Group X Instructions X Reading X Content Structure | | 4.04 | .0038* | | |
| Physics-Music X (Gen-SH & SH-SL) X 1st-2nd X High-Int | | | | 0.06 | .9383 |
| Physics-Music X (Gen-SH & SH-SL) X 1st-2nd X Int-Low | | | | 7.06 | .0015* |
| H. Group X Instructions X Text X Reading X Content Structure | | 1.63 | .1207 | | |
| Physics-Music X (Gen-SH & SH-SL) X Laser-Notation X 1st-2nd X High-Int | | | | 3.58 | .0324 |

TABLE 1J (Continued)

*Nonorthogonal MANOVA of Transformed (LN X) Reading Rates (WPM) for All Sentences*

| Source of Variation | df | Multivariate F | Multivariate p | Univariate F | Univariate p |
|---|---|---|---|---|---|
| Physics-Music X (Gen-SH & SH-SL) X Laser-Notation X 1st-2nd X Int-Low | | | | 1.15 | .3226 |
| Physics-Music X (Gen-SH & SH-SL) X Laser-Parakeet X 1st-2nd X High-Int | | | | 4.29 | .0170 |
| Physics-Music X (Gen-SH & SH-SL) X Laser-Parakeet X 1st-2nd X Int-Low | | | | 3.07 | .0516 |

TABLE 2J

Nonorthogonal MANOVA of Transformed (LN X) Reading Rates (WPM) for Target Sentences

| | | Multivariate | | Univariate | |
|---|---|---|---|---|---|
| Source of Variation | df | F | p | F | p |
| I. Grand Mean | 1 | | | | |
| A. Text | | 67.41 | .0001* | | |
| Laser-Notation | | | | 44.12 | .0001* |
| Laser-Parakeet | | | | 135.46 | .0001* |
| B. Reading | | | | | |
| 1st-2nd | | | | 262.91 | .0001* |
| C. Content Structure | | | | | |
| High-Low | | | | 20.83 | .0001* |
| D. Text X Reading | | 17.10 | .0001* | | |
| Laser-Notation X 1st-2nd | | | | 12.66 | .0001* |
| Laser-Parakeet X 1st-2nd | | | | 31.30 | .0001* |

*$\alpha$ = .01

TABLE 2J (Continued)

Nonorthogonal MANOVA of Transformed (LN X) Reading Rates (WPM) for Target Sentences

| Source of Variation | df | Multivariate F | Multivariate p | Univariate F | Univariate p |
|---|---|---|---|---|---|
| E. Text X Content Structure | | 103.48 | .0001* | | |
| Laser-Notation X High-Low | | | | 0.23 | .6340 |
| Laser-Parakeet X High-Low | | | | 131.29 | .0001* |
| F. Reading X Content Structure | | | | | |
| 1st-2nd X High-Low | | | | 15.17 | .0002* |
| G. Text X Reading X Content Structure | | 6.66 | .0021* | | |
| Laser-Notation X 1st-2nd X High-Low | | | | 1.39 | .2425 |
| Laser-Parakeet X 1st-2nd X High-Low | | | | 13.36 | .0005* |
| II. Group | 1 | | | | |
| A. Sum | | | | | |
| Physics-Music | | | | 0.66 | .4185 |
| B. Group X Text | | 14.00 | .0001* | | |
| Physics-Music X Laser-Notation | | | | 26.47 | .0001* |
| Physics-Music X Laser-Parakeet | | | | 13.96 | .0004* |

TABLE 2J (Continued)

Nonorthogonal MANOVA of Transformed (LN X) Reading Rates (WPM) for Target Sentences

| Source of Variation | df | Multivariate F | Multivariate p | Univariate F | Univariate p |
|---|---|---|---|---|---|
| C. Group X Reading | | | | | |
| Physics-Music X 1st-2nd | | | | 0.23 | .6329 |
| D. Group X Content Structure | | | | | |
| Physics-Music X High-Low | | | | 0.58 | .4476 |
| E. Group X Text X Reading | | 3.99 | .0222 | | |
| Physics-Music X Laser-Notation X 1st-2nd | | | | 7.85 | .0063 |
| Physics-Music X Laser-Parakeet X 1st-2nd | | | | 0.23 | .6360 |
| F. Group X Text X Content Structure | | 1.90 | .1567 | | |
| Physics-Music X Laser-Notation X High-Low | | | | 3.01 | .0865 |
| Physics-Music X Laser-Parakeet X High-Low | | | | 0.16 | .6875 |
| G. Group X Reading X Content Structure | | | | | |
| Physics-Music X 1st-2nd X High-Low | | | | 0.25 | .6195 |

TABLE 2J (Continued)

Nonorthogonal MANOVA of Transformed (LN X) Reading Rates (WPM) for Target Sentences

| | | Multivariate | | Univariate | |
|---|---|---|---|---|---|
| Source of Variation | df | F | p | F | p |
| H. Group X Text X Reading X Content Structure | | 1.26 | .2894 | | |
| Physics-Music X Laser-Notation X 1st-2nd X High-Low | | | | 2.55 | .1144 |
| Physics-Music X Laser-Parakeet X 1st-2nd X High-Low | | | | 0.17 | .6817 |
| III. Instructions | 1 | | | | |
| A. Sum | | | | | |
| General-Specific High (Gen-SH) | | | | 1.61 | .2059 |
| Specific High-Specific Low (SH-SL) | | | | | |
| B. Instructions X Text | | 2.55 | .0414 | | |
| (Gen-SH & SH-SL) X Laser-Notation | | | | 0.35 | .7070 |
| (Gen-SH & SH-SL) X Laser-Parakeet | | | | 3.53 | .0339 |
| C. Instructions X Reading | | | | | |
| (Gen-SH & SH-SL) X 1st-2nd | | | | 1.17 | .3166 |

TABLE 2J (Continued)

Nonorthogonal MANOVA of Transformed (LN X) Reading Rates (WPM) for Target Sentences

| | | Multivariate | | Univariate | |
|---|---|---|---|---|---|
| Source of Variation | df | F | p | F | p |
| D. Instructions X Content Structure | | | | | |
| (Gen-SH & SH-SL) X High-Low | | | | 6.73 | .0020* |
| E. Instructions X Text X Reading | | 5.26 | .0006* | | |
| (Gen-SH & SH-SL) X Laser-Notation X 1st-2nd | | | | 2.40 | .0968 |
| (Gen-SH & SH-SL) X Laser-Parakeet X 1st-2nd | | | | 9.13 | .0003* |
| F. Instructions X Text X Content Structure | | 0.48 | .7493 | | |
| (Gen-SH & SH-SL) X Laser-Notation X High-Low | | | | 0.27 | .7625 |
| (Gen-SH & SH-SL) X Laser-Parakeet X High-Low | | | | 0.21 | .8082 |
| G. Instructions X Reading X Content Structure | | | | | |
| (Gen-SH & SH-SL) X 1st-2nd X High-Low | | | | 0.02 | .9763 |
| H. Instructions X Text X Reading X Content Structure | | 1.94 | .1066 | | |
| (Gen-SH & SH-SL) X Laser-Notation X 1st-2nd X High-Low | | | | 3.53 | .0337 |
| (Gen-SH & SH-SL) X Laser-Parakeet X 1st-2nd X High-Low | | | | 0.56 | .5752 |

TABLE 2J (Continued)

Nonorthogonal MANOVA of Transformed (LN X) Reading Rates (WPM) for Target Sentences

| Source of Variation | df | Multivariate F | Multivariate p | Univariate F | Univariate p |
|---|---|---|---|---|---|
| IV. Group X Instructions | 2 | | | | |
| A. Sum | | | | 1.35 | .2641 |
| Physics-Music X (Gen-SH & SH-SL) | | | | | |
| B. Group X Instructions X Text | | 1.02 | .3985 | | |
| Physics-Music X (Gen-SH & SH-SL) X Laser-Notation | | | | 1.81 | .1694 |
| Physics-Music X (Gen-SH & SH-SL) X Laser-Parakeet | | | | 0.35 | .7075 |
| C. Group X Instructions X Reading | | | | 2.24 | .1125 |
| Physics-Music X (Gen-SH & SH-SL) X 1st-2nd | | | | | |
| D. Group X Instructions X Content Structure | | | | 2.53 | .0855 |
| Physics-Music X (Gen-SH & SH-SL) X High-Low | | | | | |
| E. Group X Instructions X Text X Reading | | 0.87 | .4807 | | |
| Physics-Music X (Gen-SH & SH-SL) X Laser-Notation X 1st-2nd | | | | 1.03 | .3608 |
| Physics-Music X (Gen-SH & SH-SL) X Laser-Parakeet X 1st-2nd | | | | 0.24 | .7856 |

TABLE 2J (Continued)

Nonorthogonal MANOVA of Transformed (LN X) Reading Rates (WPM) for Target Sentences

| Source of Variation | df | Multivariate F | Multivariate p | Univariate F | Univariate p |
|---|---|---|---|---|---|
| F. Group X Instructions X Text X Content Structure | | 2.12 | .0800 | | |
| Physics-Music X (Gen-SH & SH-SL) X Laser-Notation X High-Low | | | | 2.60 | .0805 |
| Physics-Music X (Gen-SH & SH-SL) X Laser-Parakeet X High-Low | | | | 3.73 | .0281 |
| G. Group X Instructions X Reading X Content Structure | | | | 2.57 | .0827 |
| Physics-Music X (Gen-SH & SH-SL) X 1st-2nd X High-Low | | | | | |
| H. Group X Instructions X Text X Reading X Content Structure | | 1.45 | .2185 | | |
| Physics-Music X (Gen-SH & SH-SL) X Laser-Notation X 1st-2nd X High-Low | | | | 2.60 | .0804 |
| Physics-Music X (Gen-SH & SH-SL) X Laser-Parakeet X 1st-2nd X High-Low | | | | 0.09 | .9176 |

TABLE 3J

Mixed-Model ANOVA of Transformed (SQRT X+0.5) Recognition Memory Errors for All Sentences

| | | Mixed Model | | Univariate | |
|---|---|---|---|---|---|
| Source of Variation | df | F | p | F | p |
| I. Grand Mean | 1 | | | | |
| A. Text | | 11.06 | .0001* | | |
| Laser-Notation | | | | 0.96 | .3295 |
| Laser-Parakeet | | | | 20.51 | .0001* |
| B. Content Structure | | 54.39 | .0001* | | |
| High-Intermediate (High-Int) | | | | 100.62 | .0001* |
| High-Low | | | | 4.14 | .0451 |
| C. Text X Content Structure | | 2.32 | .0572 | | |
| Laser-Notation X High-Int | | | | 0.08 | .7745 |
| Laser-Notation X High-Low | | | | 0.40 | .5282 |
| Laser-Parakeet X High-Int | | | | 0.02 | .8764 |
| Laser-Parakeet X High-Low | | | | 8.88 | .0041 |

* $\alpha = .01$

TABLE 3J (Continued)

Mixed-Model ANOVA of Transformed (SQRT X+0.5) Recognition Memory Errors for All Sentences

| | | Mixed Model | | Univariate | |
|---|---|---|---|---|---|
| Source of Variance | df | F | p | F | p |
| II. Group | 1 | | | | |
| A. Sum | | | | | |
| Physics X Music | | | | 1.35 | .2494 |
| B. Group X Text | | 10.79 | .0001* | | |
| Physics-Music X Laser-Notation | | | | 16.23 | .0002* |
| Physics-Music X Laser-Parakeet | | | | 5.70 | .0193 |
| C. Group X Content Structure | | 1.33 | .2666 | | |
| Physics-Music X High-Int | | | | 2.32 | .1316 |
| Physics-Music X High-Low | | | | 0.26 | .6110 |
| D. Group X Text X Content Structure | | 2.02 | .0916 | | |
| Physics-Music X Laser-Notation X High-Int | | | | 1.14 | .2889 |
| Physics-Music X Laser-Notation X High-Low | | | | 1.76 | .1885 |
| Physics-Music X Laser-Parakeet X High-Int | | | | 0.62 | .4327 |
| Physics-Music X Laser-Parakeet X High-Low | | | | 4.49 | .0371 |

TABLE 3J (Continued)

Mixed-Model ANOVA of Transformed (SQRT X+0.5) Recognition Memory Errors for All Sentences

| Source of Variation | df | Mixed Model F | Mixed Model p | Univariate F | Univariate p |
|---|---|---|---|---|---|
| III. Instructions | 2 | | | | |
| A. Sum | | | | 0.40 | .6695 |
| B. Instructions X Text | | 0.22 | .9285 | | |
| (Gen-SH & SH-SL) X Laser-Notation | | | | 0.13 | .8787 |
| (Gen-SH & SH-SL) X Laser-Parakeet | | | | 0.30 | .7419 |
| C. Instructions X Content Structure | | 0.95 | .4383 | | |
| (Gen-SH & SH-SL) X High-Int | | | | 0.10 | .9015 |
| (Gen-SH & SH-SL) X High-Low | | | | 1.86 | .1616 |
| D. Instructions X Text X Content Structure | | 0.70 | .6909 | | |
| (Gen-SH & SH-SL) X Laser-Notation X High-Int | | | | 0.21 | .8119 |
| (Gen-SH & SH-SL) X Laser-Notation X High-Low | | | | 1.25 | .2923 |
| (Gen-SH & SH-SL) X Laser-Parakeet X High-Int | | | | 1.04 | .3568 |
| (Gen-SH & SH-SL) X Laser-Parakeet X High-Low | | | | 0.36 | .6978 |

TABLE 3J (Continued)

Mixed-Model ANOVA of Transformed (SQRT X+0.5) Recognition Memory Errors for All Sentences

| Source of Variation | df | Mixed Model F | Mixed Model p | Univariate F | Univariate p |
|---|---|---|---|---|---|
| IV. Group X Instructions | 2 | | | | |
| A. Sum | | | | 0.57 | .5668 |
| Physics-Music X (Gen-SH & SH-SL) | | | | | |
| B. Group X Instructions X Text | | 0.28 | .8894 | | |
| Physics-Music X (Gen-SH & SH-SL) X Laser-Notation | | | | 0.08 | .9207 |
| Physics-Music X (Gen-SH & SH-SL) X Laser-Parakeet | | | | 0.47 | .6277 |
| C. Group X Instructions X Content Structure | | 0.36 | .8374 | | |
| Physics-Music X (Gen-SH & SH-SL) X High-Int | | | | 0.44 | .6440 |
| Physics-Music X (Gen-SH & SH-SL) X High-low | | | | 0.27 | .7649 |
| D. Group X Instructions X Text X Content Structure | | 2.05 | .0400 | | |
| Physics-Music X (Gen-SH & SH-SL) X Laser-Notation X High-Int | | | | 0.10 | .9026 |
| Physics-Music X (Gen-SH & SH-SL) X Laser-Notation X High-Low | | | | 1.74 | .1822 |

TABLE 3J (Continued)

Mixed-Model ANOVA of Transformed (SQRT X+0.5) Recognition Memory Errors for All Sentences

| | | Mixed Model | | Univariate | |
|---|---|---|---|---|---|
| Source of Variation | df | F | p | F | p |
| Physics-Music X (Gen-SH & SH-SL) X Laser-Parakeet X High-Int | | | | 1.39 | .2551 |
| Physics-Music X (Gen-SH & SH-SL) X Laser-Parakeet X High-Low | | | | 5.08 | .0083 |

TABLE 4J

Mixed-Model ANOVA of Transformed (SQRT X+0.5) Recognition Memory Errors for Targeted Sentences

| Source of Variation | df | Mixed Model F | Mixed Model p | Univariate F | Univariate p |
|---|---|---|---|---|---|
| I. Grand Mean | 1 | | | | |
| A. Text | | 16.20 | .0001* | | |
| Laser-Notation | | | | 5.89 | .0174 |
| Laser-Parakeet | | | | 25.68 | .0001* |
| B. Content Structure | | | | | |
| High-Low | | | | 0.93 | .3386 |
| C. Text X Content Structure | | 12.33 | .0001* | | |
| Laser-Notation X High-Low | | | | 15.98 | .0002* |
| Laser-Parakeet X High-Low | | | | 7.11 | .0092* |
| II. Group | 1 | | | | |
| A. Sum | | | | | |
| Physics-Music | | | | 6.17 | .0150 |

*$\alpha$ = .01

TABLE 4J (Continued)

Mixed-Model ANOVA of Transformed (SQRT X+0.5) Recognition Memory Errors for Targeted Sentences

| | | Mixed Model | | Univariate | |
|---|---|---|---|---|---|
| Source of Variation | df | F | p | F | p |
| B. Group X Text | | 7.10 | .0011* | | |
| Physics-Music X Laser-Notation | | | | 5.29 | .0240 |
| Physics-Music X Laser-Parakeets | | | | 8.77 | .0040* |
| C. Group X Content Structure | | | | | |
| Physics-Music X High-Low | | | | 0.03 | .8744 |
| D. Group X Text X Content Structure | | 4.15 | .0175 | | |
| Physics-Music X Laser-Notation X High-Low | | | | 2.27 | .1354 |
| Physics-Music X Laser-Parakeet X High-Low | | | | 6.84 | .0106 |
| III. Instructions | 2 | | | | |
| A. Sum | | | | 1.23 | .2984 |
| General-Specific High (Gen-SH)<br>Specific High-Specific Low (SH-SL) | | | | | |

TABLE 4J (Continued)

Mixed-Model ANOVA of Transformed (SQRT X+0.5) Recognition Memory Errors for Targeted Sentences

| Source of Variation | df | Mixed Model F | Mixed Model p | Univariate F | Univariate p |
|---|---|---|---|---|---|
| B. Instructions X Text | | 0.59 | .6700 | | |
| (Gen-SH & SH-SL) X Laser-Notation | | | | 0.56 | .5745 |
| (Gen-SH & SH-SL) X Laser-Parakeet | | | | 0.62 | .5402 |
| C. Instructions X Content Structure | | | | 1.55 | .2174 |
| (Gen-SH & SH-SL) X High-Low | | | | | |
| D. Instructions X Text X Content Structure | | 0.50 | .7339 | | |
| (Gen-SH & SH-SL) X Laser-Music X High-Low | | | | 0.55 | .5807 |
| (Gen-SH & SH-SL) X Laser-Parakeet X High-Low | | | | 0.44 | .6463 |
| IV. Group X Instructions | 2 | | | | |
| A. Sum | | | 0.34 | .7096 | |
| Physics-Music X (Gen-SH & SH-SL) | | | | | |

TABLE 4J (Continued)

Mixed-Model ANOVA of Transformed (SQRT X+0.5) Recognition Memory Errors for Targeted Sentences

| Source of Variation | df | Mixed Model F | Mixed Model p | Univariate F | Univariate p |
|---|---|---|---|---|---|
| B. Instructions X Text | | 0.59 | .6700 | | |
| (Gen-SH & SH-SL) X Laser-Notation | | | | 0.56 | .5745 |
| (Gen-SH & SH-SL) X Laser-Parakeet | | | | 0.62 | .5402 |
| C. Instructions X Content Structure | | | | 1.55 | .2174 |
| (Gen-SH & SH-SL) X High-Low | | | | | |
| D. Instructions X Text X Content Structure | | 0.50 | .7339 | | |
| (Gen-SH & SH-SL) X Laser-Music X High-Low | | | | 0.55 | .5807 |
| (Gen-SH & SH-SL) X Laser-Parakeet X High-Low | | | | 0.44 | .6463 |
| IV. Group X Instructions | 2 | | | | |
| A. Sum | | | 0.34 | .7096 | |
| Physics-Music X (Gen-SH & SH-SL) | | | | | |

TABLE 4J (Continued)

Mixed-Model ANOVA of Transformed (SQRT X+0.5) Recognition Memory Errors for Targeted Sentences

| Source of Variation | df | Mixed Model F | Mixed Model p | Univariate F | Univariate p |
|---|---|---|---|---|---|
| B. Group X Instructions X Text | | 0.49 | .7448 | | |
| Physics-Music X (Gen-SH & SH-SL) X Laser-Notaticn | | | | 0.11 | .8917 |
| Physics-Music X (Gen-SH & SH-SL) X Laser-Parakeet | | | | 0.83 | .4393 |
| C. Group X Instructions X Content Structure | | | | 0.02 | .9779 |
| Physics-Music X (Gen-SH & SH-SL) X High-Low | | | | | |
| D. Group X Instructions X Text X Content Structure | | 2.76 | .0295 | | |
| Physics-Music X (Gen-SH & SH-SL) X Laser-Notation X High-Low | | | | 2.43 | .0942 |
| Physics-Music X (Gen-SH & SH-SL) X Laser-Parakeet X High-Low | | | | 3.23 | .0444 |